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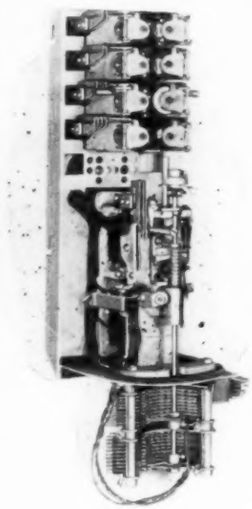
VOLUME XXVI AUGUST, 1922 Number 8



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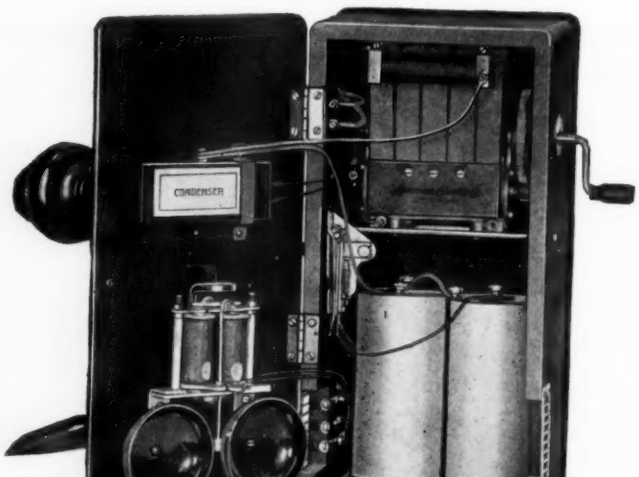

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The No. X69 offers features not found in any other types of wall telephones. The placing of the bells on the inside of the cabinet is a very clever departure from previous practice, which permits the use of a much smaller, neater cabinet, reduces the wiring, simplifies the assembly, and makes all parts easily accessible. Neatness and efficiency are combined in this instrument to assure a service that will mean satisfied customers.

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VOL. XXVI AUGUST, 1922 NUMBER 8

Underground for Small Plants

Service Betterment, Depreciation and Complaint Reduction Result from This Easy and Practical Underground Construction—Get a Century Plant

By R. W. Garner

Plant Superintendent, Texas Telephone Company

(Presented at Texas Telephone Convention)

From the experience of telephone companies operating in the large cities of the country, it is proven that depreciation, or deterioration, is not more than one-half as great in plants in such places, as in the plant located in the average sized town, or city, which of course means that a plant in large cities, (in spite of the growth and development causing constant changes in plant to keep up with the progress of cities), has twice the life of those in the smaller cities or towns.

The realization of such facts causes us to wonder if we can not in some way stretch the length of life of our plants, and, along with it, eliminate constant replacements, worlds of trouble and poor service.

Underground Relief

In considering ways and means of bringing this about it occurs that our relief must come by use of more substantial plants and underground cable. Of course underground cable as we generally know it—of the type used in the cities—requiring conduit, manholes, etc., is entirely out of the question for a small exchange with three, four, five hundred, or even many more subscribers. Then, if this is out of our reach, what can we do for ourselves? What I say from now on is in an effort to help solve this problem and suggest a relief which is entirely within reach of an exchange of moderate size and if the plans should be adopted, my honest belief is, that the depreciation and maintenance costs will be reduced to even a smaller figure than that of the large city plant which is almost entirely underground. My reason for feeling that it would be lower, is, that in the small town or city, the growth and changes will not be near so great as in the large city, hence not so much loss from abandonment and changes resulting from inadequacy.

It is entirely feasible and practical to place all main and branch cables, directly in the ground, without the use of conduit, and, when the life of the cable plant and the extremely low maintenance cost is considered, it pays to do it.

Lead Good For 100 Years

Lead caskets have been exhumed, which have been in the ground as much as 100 years and found to be in a perfect state of preservation, showing, that so far as the lead was concerned, it was good for another 100 years, more or less. But I am sure the average telephone plant owner would be satisfied with only 100 years, though no doubt, if he had his plant built this way, he would live that long, or longer, because he would be free from a multitude of plant maintenance items, which he has to worry about continually, when the plant is of aerial construction. Worry shortens a man's life, (so the wise ones say), and if a telephone man could get away from the worry caused by fire, wind, rain, lightning, moving poles, house movers, sleet, rust, pole rot, slack wires, small boys shooting

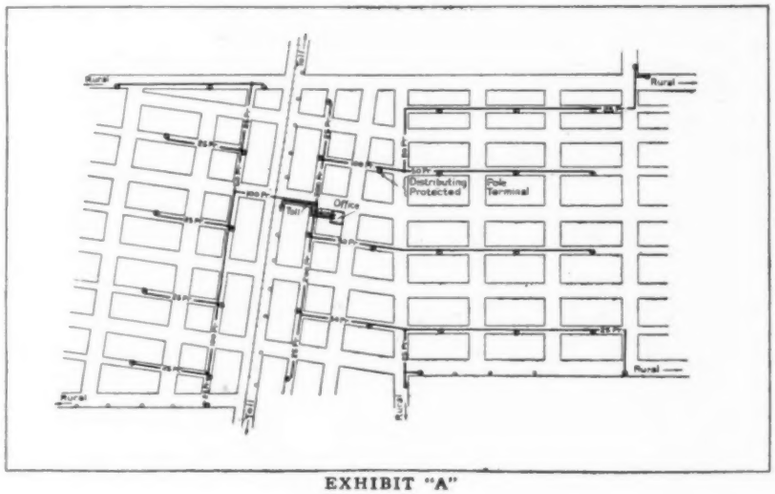


EXHIBIT "A"

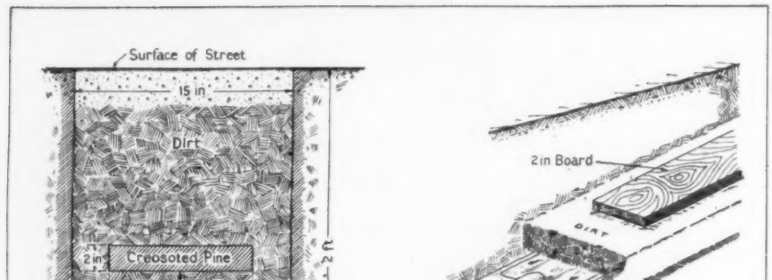


EXHIBIT "B" EXHIBIT "C"

sparrows, tree interference and woodpeckers, he would have just that much more time to "shoot the trouble" out of his own system and thereby prolong his allotted time.

The charts which have been prepared and are here used, illustrate a cable lay-out for an average small town.

Exhibit "A" covers a piant wherein all cables are laid in the dirt, but one distributing pole is used in each block. Under this plan, protected terminals should be used on each pole and twisted pair No. 17 drop wire carried to the building. Protected terminals are necessary because of possible contact between the No. 17 drop wire and electric light wires, and are designed to protect your cable as well as the telephone and building in which the instrument is located.

Exhibit "B" is an actual size sectional end-view of cable laid in the ground. Exhibit "C" is a perspective view of it. Exhibit "D" is a view of a small underground box in which is placed an unprotected terminal—simply a connecting box, for connecting subscribers' "drops" to underground cable. Exhibit "E" shows a method of draining long lines of lightning and static discharges.

Now to proceed with the construction of the main feeder cable: First, locate all service pipes—water, gas, etc., entering business houses and residences, at right angles to the line which your cable will take. Drive stakes to mark the location of these pipes. Then with a plow, excavate as much of the ditch as possible, after which use a "bull tongue" plow in the bottom to save using a pick. In dirt, there will then be very little hand labor, it only being necessary to shovel out and shape the ditch. It is not necessary to excavate two feet, if the street or alley grades are established, but laying the cable this deep will probably avoid trouble from future excavations.

In case there is some paving on streets in the business district, sometimes you can locate your cable run between the sidewalk and the curbing in what is called the "parking." If necessary to locate the cable under paving, I would recommend the use of iron pipe or fiber conduit.

"Golden Rule" on Property

If found necessary to use the "parking" extreme care should be used in excavating. Grass sod should be carefully cut and laid aside for use in finishing, after cable is placed. All dirt should be well tamped and settled with water and all surplus dirt promptly removed.

Place the sod back, filling the joints with clear soil and wet down thoroughly. Keep your eye on a job of this kind and if you notice and settling, later, raise the sod and ram dirt under it. In other words, practice the Golden Rule with the man who owns the abutting property.

In crossing a paved street or even paralleling **under** paving for a distance of 300 or 400 feet, a machine can be obtained which will drive a 3½-inch iron pipe that distance. Then, cable can be pulled through the pipe and is removable, if the need arises, at any time in the future.

We will assume that your main cable is a 400 pair. Mount the reel on a cable cart and straddle the ditch with the cart. Lash the end of cable securely to a stake. Now lay a strip of tarred paper on the bottom of ditch—ten or twelve inches wide is sufficient. There are two reasons for using the tarred paper. First, should the soil contain any harmful salts in solution the sheath will be protected, and, second, if at any time it is necessary to dig up the cable for repairs, new branches, etc., the sheath will be clean and easy to examine or handle. If there are no pipes to interfere, use a good steady team, drive slowly over the ditch and the cable will settle into place. If pipes interfere at places the cable will have to be pulled in under them. Now lay another strip of tarred paper over cable and fill with clear dirt except at points where splices and branch cables are to be connected. After cables and terminal taps are tested and spliced, the splices should be carefully covered, (or wrapped), with tarred paper and clear dirt placed by hand and carefully firmed around ends of splice to a depth of several inches before any tamping bar is used.

Clear dirt should be used, well tamped and settled with water, if possible, to a depth of about six inches

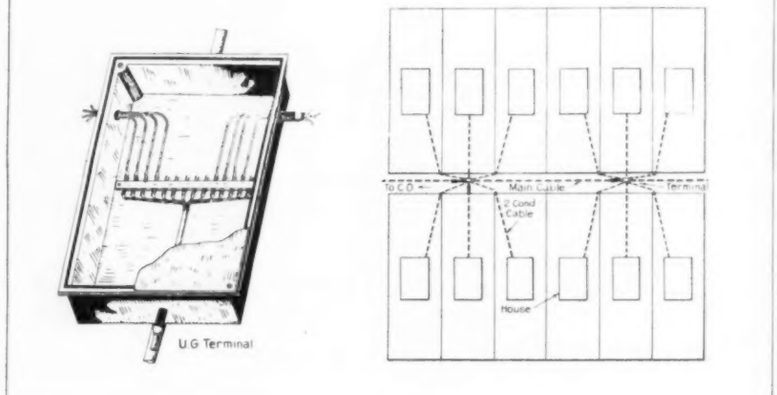


EXHIBIT "D"

on top of cable. On top of this six inches of dirt, a place a 2"x10" creosoted pine board, in ten or twelve foot lengths and fill, tamp and settle the rest of the excavation. By settling with water, you will be able to get practically all the dirt back in the ditch and thus avoid expense of hauling it away.

Preventing Plant Damage

The creosoted pine board is used as protection against future excavations and serves as a warning to the laborers that there is something below it. Careful measurements should be taken showing the location of the cable—how deep in the ground and how many feet from the property lines, and, a map made up and placed on file with the city government, who should pass an ordinance requiring all parties desiring to make any excavations in the streets or alleys to obtain a permit from the City Clerk, who would then refer them to the underground map, thus preventing damage to your underground plant in future years.

You should have no trouble in getting the Council to pass such an ordinance. Say to them that you are constructing an up-to-date, first-class plant and that your town will thereby enjoy dependable telephone service. You can always appeal to their civic pride in reducing (or eliminating entirely) the numerous poles generally used in this work, which will not only add to the appearance of the town, but will remove the objections that this pole and that pole are in the way of other improvements, etc.

If you have a Wheatstone Bridge, or a good direct reading ohmmeter, it is a good plan to record on this map the resistance and actual number of feet from your main frame to the center of each splice.

The splicer can call you as he makes up each splice and give you a "short," so you can make the reading. Then, in the future, if trouble should occur, you will be able to locate it quicker and at less expense.

In order to eliminate the use of poles for distributing to subscribers, an underground water-proof connecting box is installed (say in a 300 ft. block) 75 feet from each end of block and about three feet (along the ditch) from the splice serving that box. No protection is used in this box, the paired lead-covered "drops" being connected direct to the cable pairs by means of connecting "punchings," well soldered. Exhibit "D" shows a city block with two of these underground connecting boxes. The lead-covered paired wires are laid in the dirt, or in galvanized iron pipe, from the connecting boxes to each building. If you should have an office building requiring a number of telephones, a branch cable (laid same as feeder cables) should be carried to a shaft, closet, or hallway and terminate in an unprotected terminal.

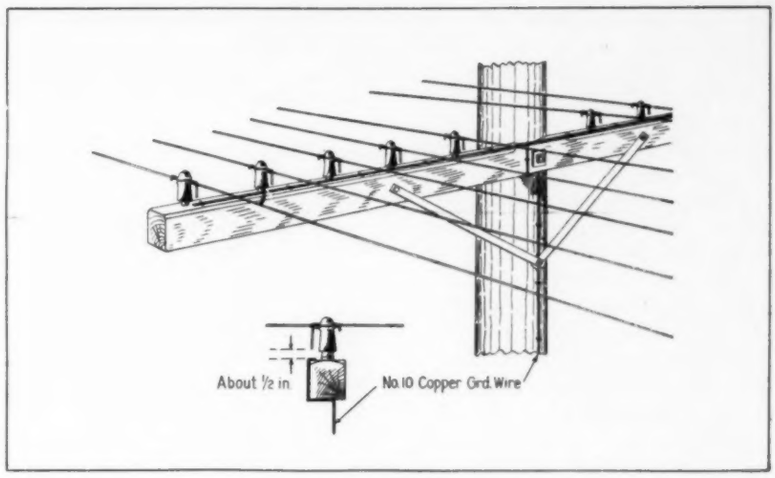


EXHIBIT "E"

The expense of laying the lead-covered "drops" should be borne by the property owner, (same as water and gas service pipes) at least to the street or alley line.

At the city limits, on all established county roads (in order to connect with aerial rural lines), bring the cable up a pole through an iron pipe-bend and riser, (placed at bottom of pole), with about eight feet of iron pipe above the ground. Have splicer wipe a cap on top of pipe to keep water from running down pipe. Terminate this cable in an approved protected cable terminal and you are ready to serve your rural subscribers.

Exhibit "E" shows a method of draining long lines of lightning and static discharges. If the farmers own their lines, I would equip the cable terminal pole with this draining method and get the farmers to install these drains every mile. They will protect your cable and avoid practically all interruptions to the service. If you own the rural lines, it will pay you to protect the lines every mile with this drain.

Rural Possibilities

I fully believe it is possible and practical to lay twisted pair, paper insulated, lead-covered wire directly in the dirt for serving rural lines, and thereby get away from the heavy maintenance cost now experienced with aerial wire on pole lines.

These lines could be laid on "air-lines" directly across the fields or along the side of graded county roads, it being only necessary to lay them deep enough to be below cultivation or grading. It is also possible to get a right of way just inside the fence line along public roads and thus avoid both cultivation and grading. Care should be taken when crossing ditches, small streams, etc., to lay the wire deep enough to avoid washing out, or (still better), protect it with a piece of iron pipe at such places.

The bridging taps can be taken direct to the farm house, underground, to a point directly below the location of the telephone, from which point it should be carried up through a small iron pipe, terminating in a small iron box fitted with a lid and lock. This locked box is provided, so that when a subscriber discontinues his service, you can clear the line, absolutely, at his house, making it unnecessary to cut the tap DEAD back at the main line, as we do in aerial construction.

You can readily see some of the advantages to be gained by this type of line construction, as it eliminates storm damage caused by wind, rain, sleet and lightning. You would not even need a lightning arrester because no part of the line is exposed to lightning, and I believe you will agree with me, that if the arrester can be dispensed with, many a case of trouble will be saved, thereby making your rural service as dependable as the city subscribers enjoy.

If you have a number of rural lines leading out one road you can purchase 11 pair cable, 16 gauge at about 19 cents per foot in standard reel lengths of 2,000 feet. Or a 13 gauge, 11 pair cable, at about 28 cents per foot in standard reel lengths of 1,500 feet.

The cost of 16 gauge, paper insulated, lead covered twisted pair is approximately 7 cents per foot, and that of 14 gauge 8 cents per foot.

The kind of construction I have outlined will cost little more at first than

aerial cable construction or open wire, but first cost is almost the last cost so far as maintenance is concerned.

I am personally familiar with one 200 pair cable which was laid in the dirt about 14 years ago, and there has never been a case of trouble in it. It had a protected terminal at the end and there were several long rural lines working through it. At one time, a fire destroyed a building within ten feet of it, but of course it wasn't damaged. Had it been an aerial cable, at least 100 feet would have been destroyed and a possible 200 subscribers would have been out of service for a day or two.

Experience in Texas

I have been informed that at Alvord, Texas, the entire cable plant is laid in the dirt and has been in operation for 22 months with no trouble, so far as underground cable is concerned. Distribution of subscribers drops is effected by the use of one or two poles in each block.

I am also informed that at Gonzales, Texas, there is a 100 pair cable, which has been buried in the dirt for twenty years and is in a perfect state of preservation. At one time the pairs in this cable were badly shot up by lightning, due to no protection, but trouble was located and repaired and protection provided and it is in service today.

These instances prove conclusively that "it works," so why not adopt it?

A Pretty Prospect, What?

With a thoroughly fire proof central office (located as near the wire center of the town as possible), OWNED, —not rented, a cable plant constructed as I have outlined, proper rates covering your investment and operation of the plant, "you should worry" about anything, but an earthquake or a tornado. About the only insurance you would need would be tornado and plate glass for the central office. About the only loss you could have, would be individual telephones destroyed by fire, and your service troubles would be confined to the switchboard, telephones and tests for the rural lines.

Your toll line connections should be carried through a special toll cable, underground, from the central office to the railroad right-of-way where most toll routes pass through the town. Put an approved protected terminal at the end of toll cable and install the "drain" mentioned, on the terminal pole.

With such a telephone plant you are in a position to give first-class service to your patrons, and the best part of it is its dependability during stormy weather. This is the time when subscribers really need telephone service and we all know, with present aerial construction, it is not always possible to furnish it.

And "Oh, Boy!" Think of the peace of mind the owner of such a plant is going to enjoy when a big storm covers the country, while his neighbor's plants are lying on the ground in almost a hopeless tangle, with practically a complete replacement staring them in the face at considerable cost. The owner, who has passed through an experience of this kind, knows how it feels to have to dig up those hard-earned "simoleons," to put himself back on the map, while the owner of an underground plant, (such as I have outlined), is not only practically immune from storm damage but knows that he will never have to replace poles, messenger wire, anchor rods, guy wire, all kinds of hardware, cable, cable rings, open wire, (both line and drop), cable terminals, crossarms, glass, etc. Sounds good, doesn't it?

One man could easily manage and maintain a one thousand station exchange of this kind and have plenty of time to devote to his family and himself, so he could round out the aforementioned one hundred years.

H. E. Grey to Boss Fort Wayne's Construction Work

Fort Wayne, Ind.—H. E. Grey, formerly of J. G. Wray & Co., who has been here for a year making a development study, has been secured as general plant superintendent to carry out the extensive construction plans of the Fort Wayne utility. Grey's telephone experience covers a 16-year period spent with the Southwestern Bell and Topping Valuation Co., prior to his connection with the Wray organization.

Milwaukee, Wis.—Wisconsin Telephone Co. traffic records for the past year show an increase of 23,359 calls a day, bringing the total to 1,049,814 calls daily. The toll average daily was 19,885.

New York City.—An over-subscription greeted the announcement of the New York Telephone Co. $25,000,000 stock issue's one-day selling campaign. More than 70,000 subscribers applied.

Kenosha, Wis.—A local ice cream company has sued the Wisconsin Telephone Co. for $4,000, alleging damage to the plaintiff's business due to the omission of its number from the telephone directory.

What Bright Salesman Craves a Jaunt to Esthonia?

Reval, Esthonia.—U. S. Vice Consul Gregg Fuller reports the Esthonian telephone system, inherited from the Russian regime, is in imperative need of betterment. There are private lines of the soviet mission, to Petrograd, and a submarine cable to Helsingfors. A few antiquated and seldom used toll lines exist. There is a demand for a 25,000 line switchboard in this city of 130,000 inhabitants. At present there are only 2,000 subscribers. The chief engineer of the system is investigating German, Belgian and Swedish equipment. City officials want some American expert to study their requirements and make recommendations. Annual rates are $12 for residence phones and $24 for business installations, plus one-third of a cent a call. Operators get $12 a month; supervisors, $18. An operator must have the equivalent of a high school education and speak Esthonian, Russian and German. She gets $6 a month while learning.

Standard Underground Makes Executive Appointments

Pittsburgh, Pa.—H. D. Shute, Vice-President and General Sales Manager of the Westinghouse Electric & Manufacturing Co., has been elected a member of the Board of Directors of the Standard Underground Cable Co., and A. B. Saurman, General Sales Manager of the Standard Underground Cable Co., has been elected Vice-President of the company and will combine the duties of his new office with those of General Manager of Sales.

Ohio Farmers' Mutuals Must Have Commission O. K.

Columbus, O.—One of the most hotly contested suits ever presented before the Ohio Supreme Court has been decided against the Mercer County Mutual Telephone Co. The company, composed principally of farmers, is subject to the same laws as a company organized for profit and must apply for a certificate of necessity to enter a field already served, so the court decided in the precedent establishing case.

New York City.—Bell stock continues to be in great demand. Shareholders are increasing about 3,000 a month. On June 30, there were 204,000 registered. George F. Baker, the banker, was the largest individual shareholder, having increased his holdings from 18,436 the previous year to 31,588 on March 18. The average individual holding is estimated at 28 shares.

Phone's Creator Gets Last Call

Doctor Alexander Graham Bell Dies at Canadian Home—Attained Fame Early in Life and Kept Active with Notable Diversified Inventions and Research

Sydney, N. S.—Dr. Alexander Graham Bell died August 2 at his estate near Baddeck, having been in declining health for the past several months. Anaemia caused the death of the distinguished inventor, whose 75 years were crowded with achievements in widely separated fields. He was born in Edinburgh, Scotland.

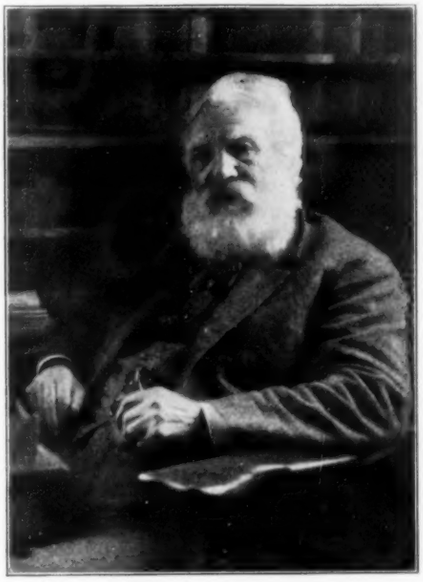
He will be buried at the top of Mount Beinn Breagh, near the site of the laboratory he has occupied since 1886, and where he maintained his private museum showing the development of his inventions.

Dr. Bell's invention of the telephone, the patents for which were sustained after spirited litigation, resulted from experiments begun with a dead man's ear. For two generations previous, the Bell family had been concerned with problems of speech. His grandfather invented a system for overcoming stammering, and his father was responsible for a system of visible speech. While a boy, Dr. Bell constructed an artificial skull of rubber that would produce weird tones when actuated by a hand bellows.

He became a teacher of elocution, and an instructor of deaf mutes. His fame soon spread across the Atlantic and he left London, where he was teaching, to become a member of the staff of Boston University. He was 24 years old at the time.

About this date he met Sir Charles Wheatstone, the English electrical inventor, and became interested in inventing a multiple, or musical telephone. Efforts along these lines resulted in the invention of the telephone.

On his 29th birthday, Dr. Bell received his patent on the telephone. The three years preceding had been spent in night work on the invention in a cellar at Salem, Mass. His work



Dr. Alexander Graham Bell

was financed by Thomas Sanders, owner of the cellar, and by Gardiner G. Hubbard, the father of a formerly deaf-mute pupil whom Dr. Bell married.

Three months after the patents had been granted, the Bell telephone was exhibited at the Philadelphia Centennial exhibit, and was accorded fitting attention by the many men of science who visited the exposition.

Dr. Bell figured in other important inventions, among them the graphophone, a method of lithography, an induction balance, and a photophone. He invented the telephone probe which he used to locate the bullet that killed President Garfield. He encouraged Samuel P. Langley to invent the first flying machine, and was prominent in promoting the progress of aerial inventions. During the world war Dr. Bell and F. W. Baldwin invented a hydrodrome which attained a speed of 70 miles an hour, and was said to be the fastest boat in the world. Its use for submarine chasing and scouting was prevented by the armistice.

Many honors at home and abroad have been accorded Dr. Bell. The French government bestowed upon him the decoration of the Legion of Honor, the French Academy, its Volta prize of 50,000 francs, and Ph.D. degrees were conferred by the Society of Arts in London and by the University of Wurzburg, Bavaria.

Condolences have been sent Dr. Bell's widow by hundreds of men and women in all parts of the world. In his message of sympathy President Harding struck the common keynote in saying of Doctor Bell, "He will be mourned by humankind everywhere as one who served it greatly, untiringly and unselfishly."

Flags on telephone company buildings throughout the country were at half mast until after the funeral.

Toledo Home Retires Over $1,000,000 Bonds

Toledo, O.—The Toledo "News-Bee" says: Bonds of the Toledo Home Telephone Co., which are held mostly by Toledo people, were paid off July 1. The issue totaled over $1,000,000. Toledo became the center of the Independent telephone movement 25 years ago. For a time, most big promotions of Independent concerns were made by Toledo men, including James Brailey and Ed Barber, who built many Ohio cities, Detroit, Indianapolis and St. Louis; Abe Detwiler, who built San Francisco; Frank Graves and Harry Wachter, who covered Los Angeles, and Charles Sumner, who chose Seattle and Portland, Ore.

Public Radio Service Joins Sweden and Denmark

Copenhagen, Denmark.—Radio telephone service, with rates lower than telegraph, now is available for public use between Copenhagen and Bornohlm. This is Scandinavia's first public radio service.

England Uncertain About Radio Broadcasting Plans

London, Eng.—Eight broadcasting stations are being considered for operation under government control in England. Manufacturers and the Postmaster General are discussing construction, and differ regarding erection of the station by one organization, or by several, as the smaller makers desire. It is proposed that a receiving set registration charge of approximately $2.44 be adopted.

On Joint Pole Construction

Safe and Economical Joint Use of Poles Is Possible If Proper Agreements and Specifications Are Made—This Practical Paper Tells How It Can Be Done—Rental Agreements

By W. H. Curran
Plant Engineer, Indiana Bell Telephone Company

There are various reasons as to why the wire companies should consider joint pole construction in all new extensions and reconstruction when this can be done without interference to the service of either company. Not only is there economy to the companies in pole costs, but the safety of the employees, and the property of both companies is to be considered, as well as the civic appearances. It is highly important that the pole line construction be as inconspicuous as possible, and this cannot be done if the utilities continue to use large numbers of poles, each in a separate line and located on the same streets and alleys.

In many parts of the country there are city ordinances which are very drastic, as regards pole line construction, and joint use is compulsory. These laws were passed and in many instances resulted in expensive charges in the properties of all the wire using utilities. It has been observed that if the utilities go ahead on their own initiative in matters of this kind, they can avoid unfavorable legislation, and secure much more favorable plant conditions at less expense to themselves and the public.

Joint Agreement Is Necessary

To follow properly the joint use of pole line plant, some form of agreement between the utilities should be provided, concerning the matter of ownership of poles, prorating of expense, liability features, construction methods, etc. There are several forms of joint agreements such as:

(a) The Joint Ownership Agreement.

(b) The Pole Rental Agreement.

(c) The Contact Rental Agreement and Others.

There are points in favor of each of these agreements, but the Pole Rental Agreement, in most features, covers the situation the best of any in use. Under this form of agreement, each Company owns entirely its own poles, but grants to the joint user the rights of occupancy. The use is permitted on payment of annual rental for each pole occupied.

Rental Agreement Has Many Advantages

There are several advantages in the Rental Form of Agreement over the other types, for example each company owns entirely its own poles; this is desirable from the standpoint of records, appraisals, tax returns, etc. In many plants the sale of an interest in pole lines is impracticable, due to mortgages on the property, etc. Another advantage in having the poles solely owned by one company or the other, is in the matter of repairs, rearrangements, replacements, etc. There is an advantage in the Pole Rental Agreement, as it is only necessary to keep a record of the poles occupied jointly, whereas in the Contact rental form, it is necessary to keep detail records of the number and size of attachments, and to make frequent detail field inspections of the plant to note any changes.

Under the Joint Ownership Agreement, there is a considerable amount of billing expense and clerical work involved on each joint pole set, whereas in the Pole Rental Agreement, billing is rendered annually by each Company, to cover the poles occupied.

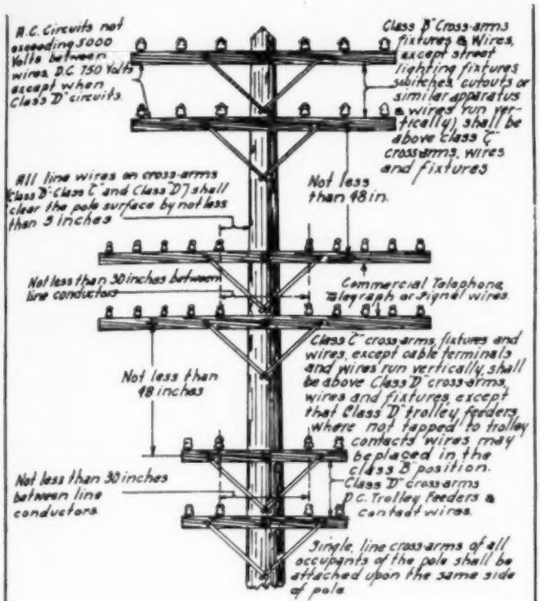
Rental Rate Determined from Annual Charge

As a general rule no charge is made for service or clearance contacts in the Rental Agreement. The Rental rate is obtained by determining the size and value of the average pole in plant, both companies' property being considered. (In exchange work a 35′ pole is usually found to be an average size.) The proper Annual Charge rate for pole lines is then used and applied to the average pole, the rental rate being one-half this charge. For example, assume an average 35 ft. pole at $20.00, and an Annual Charge rate of 12.5%. The Annual Charges would then be $2.50 per pole; one-half this amount, or $1.25 per annum would be the rate charged for joint occupancy.

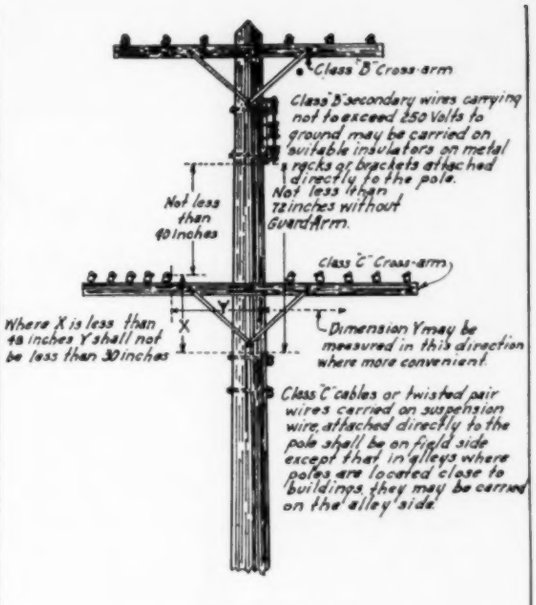
The usual practice is for each company to maintain as nearly as possible an equal number of poles that are jointly occupied. If this is done, there will be a minimum amount of billing required. In order to maintain an equal balance of poles occupied, the Companies must work together on all extensions, and that Company which is using the lesser number of joint poles would make the extensions where these would be jointly used. This form of agreement provides that the owning company shall maintain its own poles and shall make such replacements and repairs as are required. In the event that a line of poles of the agreed size, are of insufficient height to carry additional attachments which the Licensee desires to make, the owner shall set the poles of the desired height, and shall bill the Licensee for the additional cost of the higher poles over the value of the average pole. The Company replacing the poles, takes possession of the pole displaced. Under this form of agreement each company maintains its own attachments, and makes any changes or rearrangements at its own expense. In all forms of pole agreements, there should be included the necessary Liability Clause, Arbitration Clause, Modification Clause, and Terminating Clause.

Standards of Construction Important

Another very important feature, if not the most essential, of a Joint Pole Agreement, is the provision for standards of construction. There are many features involved in the construction and maintenance of a Telephone plant, and in general these same conditions apply to the supply lines. When both plants, therefore, are joined on the same supporting structures, it is essential that all conditions be covered in a manner satisfactory to both services. For example—there is the Scope and Limitation of the circuits that can be con-


A.C. Circuits not exceeding 5000 Volts between wires, D.C. 750 Volts except when Class "D" circuits.
Class "B" Cross-arms fixtures & Wires, except street lighting fixtures, switches, cutouts or similar apparatus & wires run vertically), shall be above Class "C" cross-arms, wires and fixtures
All line wires on cross-arms Class "B" Class "C" and Class "D" shall clear the pole surface by not less than 3 inches
Not less than 48 in.
Not less than 30 inches between line conductors
Commercial Telephone, Telegraph or Signal wires
Class "C" cross-arms, fixtures and wires, except cable terminals and wires run vertically, shall be above Class "D" cross-arms, wires and fixtures, except that Class "D" trolley feeders where not tapped to trolley contacts wires, may be placed in the Class "B" position.
Not less than 48 inches
Not less than 30 inches between line conductors.
Class "D" cross-arms D.C. Trolley feeders & contact wires.
Single line cross-arms of all occupants of the pole shall be attached upon the same side of pole.

SKETCH 1.
RELATIVE POSITION OF ATTACHMENTS OF THE DIFFERENT CLASSES.


Class "B" Cross-arm
Class "B" secondary wires carrying not to exceed 250 Volts to ground, may be carried on suitable insulators on metal racks or brackets attached directly to the pole.
Not less than 40 Inches
Not less than 72 inches without Guard Arm.
Class "C" Cross-arm
Where X is less than 48 inches Y shall not be less than 30 inches
Dimension Y may be measured in this direction where more convenient.
Class "C" cables or twisted pair wires carried on suspension wire, attached directly to the pole shall be on field side except that in alleys where poles are located close to buildings, they may be carried on the alley side.

SKETCH 2.
CLASS "B" SECONDARY WIRES AND CLASS "C" SUSPENSION WIRES ATTACHED DIRECTLY TO POLE.

sidered for joint occupancy of a pole line. Then follows the Relative Positions of the Attachments, Clearance, Vertical and Horizontal, Supporting Fixtures such as Crossarms, Pins and Insulators, Brackets, Lamp Fixtures and Terminals, Guying and Stepping of Poles.

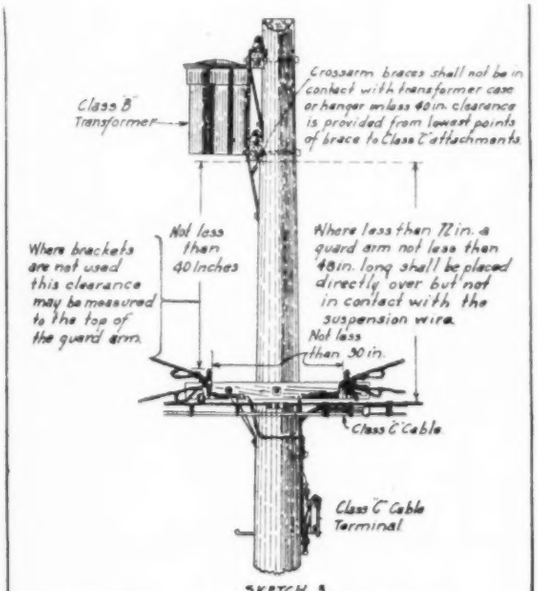
The sketches shown here cover the usual types of construction that are met in joint pole work. Each plate is described briefly in order to point out the particular requirements as to position, clearances, etc.

SKETCH I.

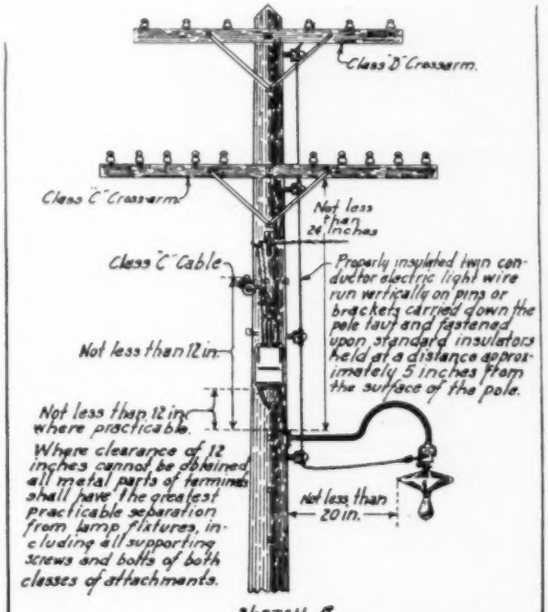
This shows the relative position of attachments of different classes showing the Vertical Clearances and Climbing Spaces. Note that the Supply Circuits are in the top spaces, with a Vertical Clearance of not less than 48 inches from the lowest Supply Crossarm to the nearest Signal Crossarm. Note also the climbing space of not less than 30" between the pole pins on the Signal Crossarms. In the case of Supply Circuits which are known as Class "D," such as trolley feeders, or contact wires, they are located at least 48" below the lowest Signal Crossarm.

SKETCH II.

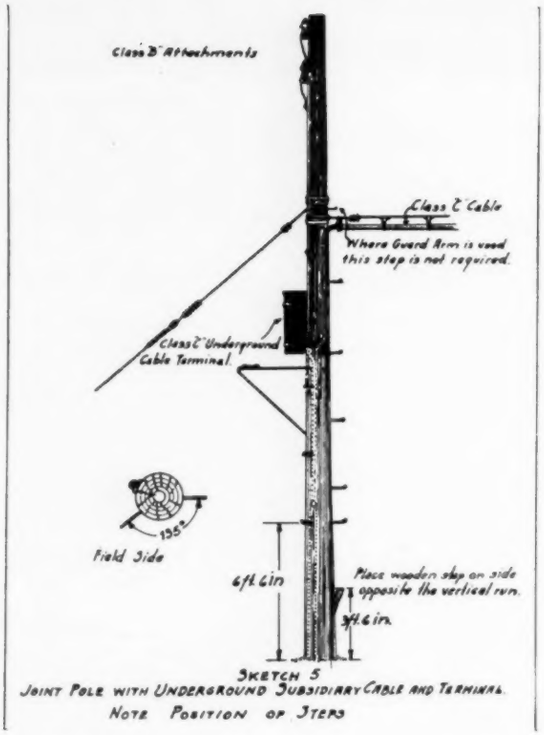
Note the relative positions of the Supply and Signal Attachments, and method of securing climbing space by closing spacing pins on Class "C" Crossarms. Note also that secondary wires may be 40" from Class "C" wires, and that 72" is maintained between secondary Class "B" circuits and Supply Cables attached directly to the pole.


Class "B" Transformer
Crossarm braces shall not be in contact with transformer case or hanger unless 40 in. clearance is provided from lowest points of brace to Class "C" attachments.
Where brackets are not used this clearance may be measured to the top of the guard arm.
Not less than 40 Inches
Where less than 72 in. a guard arm not less than 48 in. long shall be placed directly over but not in contact with the suspension wire.
Not less than 30 in.
Class "C" Cable
Class "C" Cable Terminal

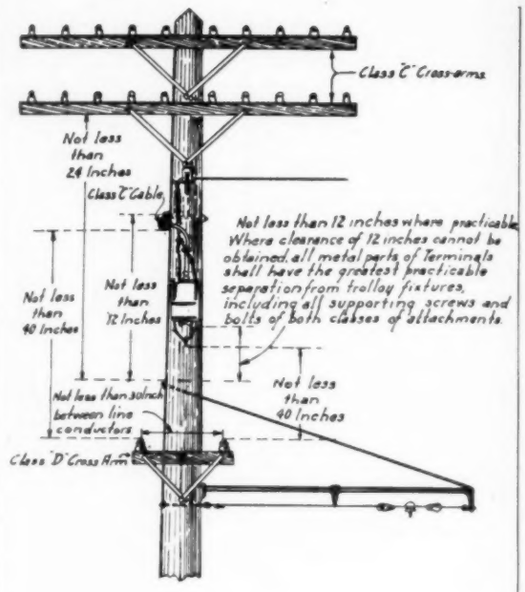
SKETCH 3
LOCATION OF CLASS "B" TRANSFORMER
NOTE POSITION OF GUARD-ARM ABOVE.


Class "D" Crossarm.
Class "C" Cross-arm
Not less than 24 Inches
Class "C" Cable
Properly insulated twin conductor electric light wire run vertically on pins or brackets carried down the pole taut and fastened upon standard insulators held at a distance approximately 5 inches from the surface of the pole.
Not less than 12 in.
Not less than 12 in. where practicable.
Where clearance of 12 inches cannot be obtained all metal parts of terminals shall have the greatest practicable separation from lamp fixtures, including all supporting screws and bolts of both classes of attachments.
Not less than 20 in.

SKETCH 4.
STREET LAMP FIXTURE ON JOINTLY OCCUPIED POLE
TWIN CONDUCTOR ON PINS AND INSULATORS


Class 'B' Attachments
Class 'C' Cable
Where Guard Arm is used this step is not required.
Class 'C' Underground Cable Terminal
135°
Field Side
6ft 6in
Place wooden step on side opposite the vertical run.
3ft 6 in.

SKETCH 5
JOINT POLE WITH UNDERGROUND SUBSIDIARY CABLE AND TERMINAL.
NOTE POSITION OF STEPS


Class 'C' Cross-arms
Not less than 24 Inches
Class 'C' Cable
Not less than 12 inches where practicable. Where clearance of 12 inches cannot be obtained, all metal parts of Terminals shall have the greatest practicable separation from trolley fixtures, including all supporting screws and bolts of both classes of attachments.
Not less than 40 Inches
Not less than 12 Inches
Not less than 40 Inches
Not less than 30 Inch between line conductors
Class 'D' Cross Arm

SKETCH 6
TROLLEY BRACKET ATTACHMENT ON JOINT POLE

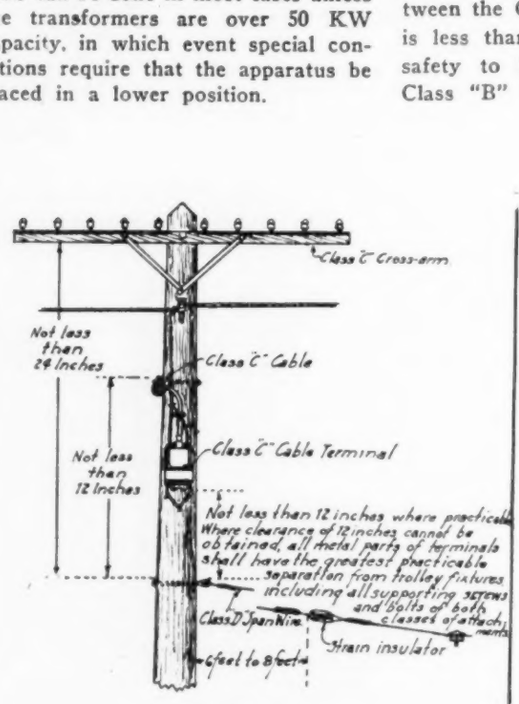
SKETCH III.

This is one of the conditions that is the source of considerable controversy between companies on the matter of joint use. The location of transformers should, whenever practicable, be above Class "C" circuits. This can be done in most cases unless the transformers are over 50 KW capacity, in which event special conditions require that the apparatus be placed in a lower position.

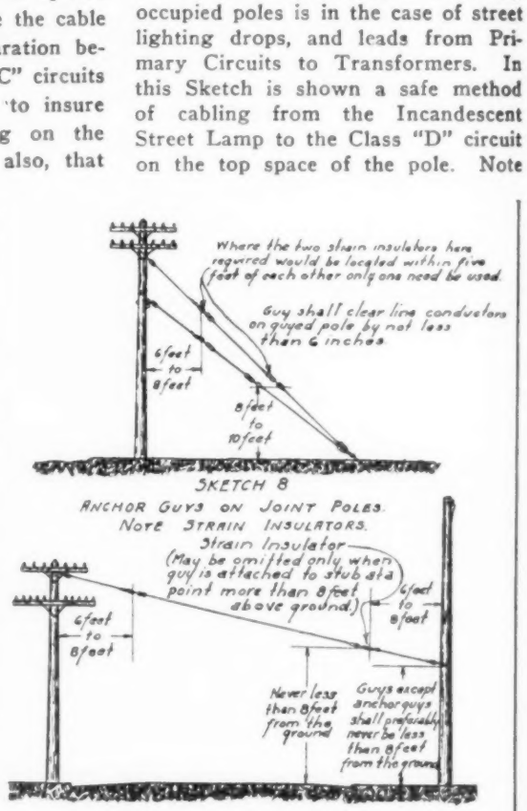
In no case is it recommended that cable terminals be placed on the same poles with transformers, if these are located below the terminal position. Note in this sketch, that a special Guard Arm is placed above the cable strand wire when the separation between the Class "B" and "C" circuits is less than 72". This is to insure safety to linemen working on the Class "B" circuits. Note also, that the climbing space is cleared by making distribution from the Guard Arm.

SKETCH IV.

One of the most frequent cases of trouble and interference on Jointly occupied poles is in the case of street lighting drops, and leads from Primary Circuits to Transformers. In this Sketch is shown a safe method of cabling from the Incandescent Street Lamp to the Class "D" circuit on the top space of the pole. Note


Class 'C' Cross-arm
Not less than 24 Inches
Class 'C' Cable
Not less than 12 Inches
Class 'C' Cable Terminal
Not less than 12 inches where practicable. Where clearance of 12 inches cannot be obtained, all metal parts of terminals shall have the greatest practicable separation from trolley fixtures including all supporting screws and bolts of both classes of attachments
Class 'D' Span Wire
Strain Insulator
6 feet to 8 feet

SKETCH 7
TROLLEY SPAN WIRE ATTACHMENT ON JOINT POLE


Where the two strain insulators here required would be located within five feet of each other only one need be used.
Guy shall clear line conductors on guyed pole by not less than 6 inches
6 feet to 8 feet
8 feet to 10 feet
Strain Insulator (May be omitted only when guy is attached to stub at a point more than 8 feet above ground.)
6 feet to 8 feet
6 feet to 8 feet
Never less than 8 feet from the ground
Guys except anchor guys shall preferably never be less than 8 feet from the ground

SKETCH 8
ANCHOR GUYS ON JOINT POLES.
NOTE STRAIN INSULATORS.

SKETCH 9
HEAD GUYS ON JOINT POLES
NOTE STRAIN INSULATORS

the pins and brackets for supporting the Twin Conductor Cable, also the clearance between the Lamps and the Class "C" circuits. It is not satisfactory to attach the lamp drops to pins fastened on the ends of the Crossarms, and this practice should not be permitted.

SKETCH V.

This Sketch shows the relative position of the Class "B" and "C" circuits, when the latter consists of cable. Note particularly the pole steps; these are quartered on the pole to avoid injury to the Underground Cable that terminates on this pole. Note that no steps are provided above the Class "C" attachments. Note also, that the Guy dead-end and the Messenger Strand are separated at the point of attachment on the pole.

SKETCHES VI, VII.

These drawings illustrate the method and position for attaching Trolley span wires and Trolley Brackets on joint poles. You will see in both cases that Strain Insulators are placed in both strand wires supporting the Trolley wire. The use of Strain Insulators is highly important, and no trolley wire attachments should be permitted, unless these are provided.

SKETCH VIII.

In this drawing is shown the method of guying, and the location of Strain Insulators in Anchor Guys. You will note two (2) Insulators are placed in each guy, one at the end next to the pole, and one at the Anchor end of the guy. These insulators must be installed in all guys, and care taken to see that they are properly located within the allowable measurements, as shown. All guys should be placed so as to maintain at least six inches clearance from the nearest line wire at the point of attachment on the guyed pole. Clearance of at least 2 feet should be maintained between any wires passed over or under by the guy wire.

SKETCH IX.

Insulators are placed in Head Guys in the same manner and under the same conditions as they are added in Anchor Guys, except that the insulator at the lower end of the Head Guy may be omitted if the point of attachment is more than 8′ above the ground.

NEW ANGLE ON PATENTS

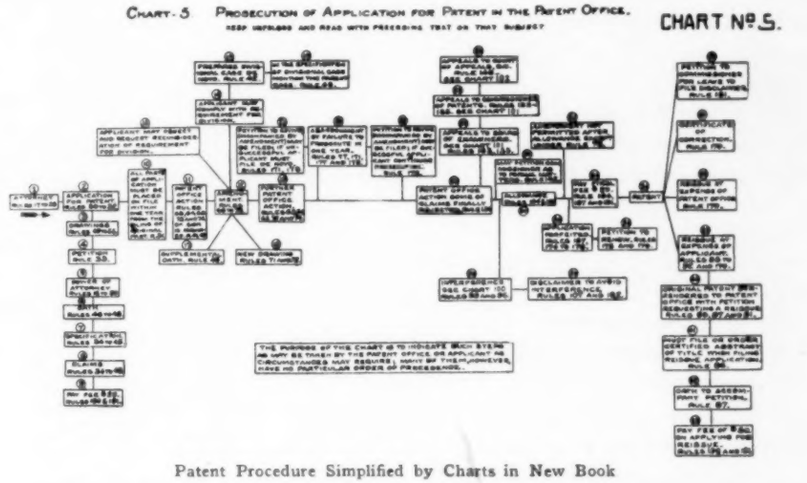
Graphic Presentation of Patent Procedure Distinguishing Feature of New Book

Washington, D. C.—"Law Charts and Patent Engineering" is the title of a new and intensely practical book in which H. H. Semmes and H. R. Van Deventer of the Westinghouse Bureau of Patent Development have collaborated.

For the first time in any volume graphs are shown which present the steps the inventor should take before presenting his case to an attorney, the steps the attorney should take when putting the patent application through the Patent Office, and the steps necessary in case the patent is litigated in the courts. Following each chapter is a chart which shows graphically the substance of the preceding reading matter.

The Semmes-Van Deventer volume is of considerable value to manufacturers, inventors, engineers, attorneys and investors, since it is a classic in completeness, accuracy and simplicity. It contains a fund of specific information to facilitate patent procedure and to determine in advance the status of the patent from the legal and commercial angles.

Copies of the limited edition of "Law Charts and Patent Engineering" may be obtained from Harry H. Semmes, care of Semmes & Semmes, McLachlen Bldg., Washington, D. C. The price is $10 a copy.



Patent Procedure Simplified by Charts in New Book

Summary of Important Points

In order to emphasize the important features of proper construction in jointly occupied pole lines, the following points are summarized briefly:

First: A good practical form of joint pole agreement is necessary; included in which should be specifications covering the type of construction to be followed by both users.

Second: Outside plant designed on sound principles and properly constructed must be kept up by efficient and economical maintenance. In this connection proper attention should be paid to the following:

(a) Substantial poles properly located and set.

(b) Strong corners.

(c) Proper guying, and particularly the placing of Strain Insulators.

(d) Clearances between different classes of circuits both horizontally and vertically.

Soil Action on Buried Cable to be Studied by Purdue

Lafayette, Ind.—The Engineering Experiment Station of Purdue University is undertaking a study of the practice of burying lead covered telephone and electrie light cable in the earth without protection. Telephone companies in Indiana and other states have hundreds of thousands of feet of buried cable, and while much of it has never been disturbed, a few cases of trouble have been experienced. Some of these cases appear to be due to corroding agents in the soil. It is with a view of determining the nature of soils in which corrosive action may take place that the present study is undertaken. The work will be done under the direction of G. A. Anderegg, Assistant Professor of Physical Chemistry and R. V. Achatz, Associate Professor of Telephone Engineering.

Three Helps in K. C. Cut-Over

Acceptance Test, Educational Work and Dispatching System Facilitate Work of Cutting Over Kansas City Exchange from Manual to Automatic—Details of Job

Kansas City, Mo.—Kansas City's cut-over from the Main (manual) office to the automatic (panel type) was successfully accomplished on the night of June 17, 1922, after approximately two and a half years of preparatory work. There were three factors which contributed primarily to the success of the cutover and the successful operation of the equipment after the cutover: First, the acceptance test; second, the educational program; third, the dispatching system used at the time of the actual cut-over.

The Acceptance Test

The acceptance test was run for the purpose of determining the amount of accuracy with which the equipment would receive and pass the calls, this test being made after the regular tests were made by the Western Electric Co. In conducting this test a large number of sending and receiving operators were used in the sending and receiving of calls. Actual subscribers' conditions were set up and the calls originated and received in the same manner as they would be if sent and received by subscribers. Each sending operator was provided with a switchboard having fifteen outgoing lines to the automatic office and by this means calls were dialed to numbers corresponding with subscribers' numbers in the automatic office and these calls answered by the receiving operators.

In addition to this arrangement, calls were sent to the various call indicator positions in the manual offices. In some cases it was not possible to release trunking positions in the manual offices during the day time and in such cases local call indicator display boxes were substituted and placed in the automatic office, duplicating the actual condition which existed in the manual office less the trunk pairs. Other means were taken to determine the exact operating condition of the call indicator positions in offices where it was not possible to release the positions. Calls were also passed from manual offices to the automatic office by means of cordless "B" positions.

In order to check up the accuracy of the dialing a recording instrument was inserted in each operator's dialing circuit and the record from this instrument was used as a check to determine whether failure to reach the proper number was chargeable to equipment error or dialing error.

All trouble tickets were thoroughly analyzed in order to ascertain the cause of the difficulty and to apply corrective measures.

There were 1,640,000 calls of various classes completed during the acceptance test, which was about 25% of the estimated total traffic.

The Educational Program

The educational program was based primarily on putting into the field a force of demonstrators to instruct subscribers in the use of the dial; in addition, such newspaper advertisements were used as was felt necessary to suit the occasion. The Flying Squadron force consisted of two field forces: One, a force composed of twenty-three men recruited from the Plant Department, which instructed the subscribers of direct, party line and intercommunicating system service; the other, a force composed of seven teams recruited from the Traffic and Commercial Departments, which instructed the P. B. X. operators and P. B. X. subscribers. These teams consisted of one young lady demonstrator and one man demonstrator.

This work started on Monday, May 29, and was completed Tuesday, June 13, four days ahead of the cutover. A very careful selection was made of all employees who were to do this work. An average was made of ten and four-tenths subscribers per man per day and eighteen and one-tenth stations per man per day by the individual, party line and I. C. S. field force. The total number of persons receiving the demonstration at subscribers' premises for this class of service was 7115.

The P. B. X. force visited a total of 247 switchboards with a total of 5380 stations, 1072 trunks and 738 attendants. These teams averaged 3.5 switchboards each per day with a total of 6837 demonstrations to the P. B. X. subscribers and their employees. It is interesting to note in passing that of the total number of stations in this class of service, 2818 were equipped with dials.

In addition to these two field forces, there were two young ladies recruited from the Traffic Department who were trained in giving the demonstrations to the civic organizations and public demonstrations in the Commercial office lobby. In the talks before the civic clubs, the demonstrators were received very courteously and the organizations showed interest to a marked degree in the demonstrations. There was a total of 2200 people given demonstrations by these two young ladies.

As the P. B. X. problem was a large one, considerable thought was given to training the P. B. X. operators in handling their boards. It was felt that they could not be instructed sufficiently at their own switchboard for the reason that most of the switchboards were very busy and the operator could not give proper attention to the instruction—over one-half of the total traffic on the Main exchange originated from these switchboards. A plan was worked out whereby the operators were asked to attend a school of instruction in the Telephone Building, a total of 564 operators being instructed in this manner. An hour's instruction was sufficient in most cases to make the operator familiar with the operation of the dial and confident of her ability to manage her board satisfactorily.

The Dispatching System

The method of handling the actual cutover work by a dispatching system contributed more than any one factor to the success of the cutover, as under this method all of the various operations and elements which entered into the cutover were considered and scheduled. The schedul-

ing was arranged so that the various items followed in sequence, thus allowing a check on the completion of the preceding items.

There were some 700 different operations to be performed during the sixteen cutover hours, which were between 11:00 a. m. Saturday the 16th and 3:00 a. m. Sunday the 17th. Distributed over the entire system were 240 men, working under the direction of the dispatcher, who were employed in making the various operations. As the work of the Traffic Department was so closely tied up with the Plant work, a traffic representative was assigned to deal with traffic employees who were checking the various items which in any way related to the traffic work.

In order that the preliminary work of setting up the detail instructions could be carried on with the least amount of interference and confusion a point of contact was made between the Plant, Traffic and Engineering departments through which the person in charge of setting up the instructions secured information. The instructions were written up as briefly as possible in an understandable way so that there would be no question as to any interpretation of an operation. After the instructions were rewritten they were checked for operation, time limit, and the person assigned to do the work.

The actual working out of this system at the start of the cutover was along the following line: Starting at the time of the cutover, the dispatcher gave orders for the first operation. As soon as this was completed it was checked off a chart which had been prepared, listing all of the operations. At the start of the operation a blue circle was placed around the operation number and when completed a red cross was drawn through the number. The entire plan was rehearsed previous to the cutover in order to acquaint the men who were to perform the different operations with the manner in which the work was to be done. The value of the rehearsal was evidenced in the smooth manner in which the various operations were performed at the time of the cutover, there being no hitch and all items being completed on schedule. At 10:00 p. m. Saturday night 80% of the trunks from the old manual office had been cut and connected to the automatic office. This allowed more than the actual trunk requirement. The cutover, insofar as the subscribers were affected, started at midnight and ended slightly before two minutes after midnight.

An interesting engineering problem in connection with the cutover was one whereby a quick conversion was made from manual call circuit position operation to call indicator position operation. In order to quickly convert these "B" positions located at manual offices, it was necessary to arrange a circuit shifting device in such a manner that the change could be made from manual to call indicator operation in a few minutes. This was accomplished by providing transfer key equipment in some offices and transfer plug equipment in other offices, depending on circuit conditions.

It is also interesting in passing to note the method of handling calls just previous to the cut, which was effected by cutting in on all existing connections to and from the old manual office at five minutes before midnight and advising the subscribers that the cutover to the new automatic office would be made during the next few minutes and if they were cut off to hang up and call again a few minutes after midnight. Special arrangements were made for handling emergency calls, such as police, fire and ambulance, during the period from 11:55 to midnight without holding them up for the cut.

On Sunday following the cut, traffic was very light which was as anticipated due to the fact that the Main office was practically a business office. On Monday traffic for the busy hour, indicated by peg count registers, was three times that of the regular normal traffic, which the equipment handled without any difficulty. This was due no doubt to the fact that many people were passing calls to see how the new equipment worked. On Tuesday the traffic dropped off considerably and continued to drop off until a fairly normal load was reached approximately two weeks after the cut.

Illinois Companies Ask Notice Before Relocating Lines

Springfield, Ill.—Illinois Telephone Companies are being advised against needless shifting of pole lines where hard surface roads are being constructed. The Illinois Telephone Association, in a notice sent out by Jay G. Mitchell, Secretary-Treasurer, suggests that a request to move a pole line be complied with only upon advice and official relocation by an authorized representative such as the engineer in charge of the Division of Highways, Department of Public Works and Buildings. Requests made by contractors should be ignored unless supported by official notice.

New Kellogg Operator's Receiver O. K.'d

Chicago, Ill.—Kellogg's new head receiver, after a year's service, is being commended by letters mentioning its fine service. Managers express their liking for this set voluntarily, because their operators are unanimous in expression of delight at having so vastly improved a head set. It weighs 2¾ ounces as compared to 6

Kellogg's No. 54-A Receiver With New Head Band. Note Simplicity of Adjustment

ounces in the old standard type. The head band of Kellogg enameled steel wire is correspondingly lighter than old style head bands. The transmission efficiency of this Kellogg operator's receiver is high. All terminals are entirely enclosed within the shell, which is non-metallic. The cap is of most approved design and screws into place with heavy threads. The diameter of the cap is 2⅛ inches. The diameter of the shell itself is 1¾ inches, total depth 1 inch. The cord terminals are secured in standard fashion of our regular receiver shells, with a convenient tie cord arrangement. The head band is instantly removable.

Kentucky Engineer Designs Railroad Line Test Set

Shelbyville, Ky.—A patent has been granted to R. B. Stone, a telephone engineer of this city, covering a light portable test set especially designed for railway telephone maintainers. The requirements for a test set suitable for use on railway telephone lines are somewhat different from other sets, and it is said that the set described will be particularly useful to those who are connected with the telephone departments of the railroads.

OPINIONS AND COMMENTS

DR. ALEXANDER GRAHAM BELL

"He will be mourned and honored by humankind everywhere as one who served it greatly, untiringly and unselfishly."

President Harding's comment on the death of the distinguished inventor of the telephone voices the thought of a nation proud that it might claim as its own a son of other shores whose greatest achievement was attained and developed in this country.

At the death of the father of telephony one marvels at the growth of his invention since its genesis in the dark and damp Salem basement. America's rapid industrial growth has been due, in no small degree, to the quickness and completeness with which the American people availed themselves of Dr. Bell's invention.

Every business and personal communication carried over telephone wires unconsciously pays a tribute to the memory of one whose efforts were primarily devoted to the relief of afflicted mankind.

Almost to the day of his death the kindly genius who brought into being the gigantic telephone industry was devoted to the cause of progress. We of the telephone industry called him ours, but shared his talents with workers in many other fields as well as with all humanity.

The death of Dr. Alexander Graham Bell is an acute loss to the industry built around his greatest invention.

BREAKING THE RULES

Long Lines, the employees' magazine of the Long Lines division of the A. T. and T. Co., carries a story of a Supervisor in one of its southern offices who was asked for a connection to telegraph operators at three different stations at the same time by a train dispatcher on the Louisville and Nashville Railway. Now the traffic rules forbid any such connections and an ordinary employee would have stood by the rules or wasted precious time in getting authority to deviate from them. Not so with this supervisor. She recognized that an emergency existed so she got all three telegraph operators on the line and timed three tickets while the dispatcher gave the train orders that probably prevented a disastrous wreck.

Rules are made to be kept and in ninety-nine cases out of the hundred should be followed. But in the hundredth case, perhaps, the rule is better broken than kept. This supervisor recognized the circumstances of the exceptional case and acted accordingly. She not only had the judgment to distinguish the necessity but she had the courage to take the responsibility for her actions. In her story she modestly says that any of the girls would have given the same service in an emergency.

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TELEPHONE ENGINEER is issued the 15th of each month. Copy can be accepted as late as the 8th of the month preceding date of publication. Where proof must be seen, allow ample time for transmission in the mails. Display Advertising—Rates on application. Classified Advertising—"Wants," "For Sales," etc.—$4 an inch, or 7 cents a word per insertion.

PUBLIC SERVICE OF JOINT POLE LINES

One of the ways of working out many of the vexing questions involved in the relations of telephone and power lines is by the use of joint pole line construction. This is being recognized not only by telephone men but by power men as well. Commenting on this our contemporary in the electric power field, Electrical World, has the following to say:

"Not only will it be necessary to safeguard the public safety and the linemen's safety, not only will it be necessary also to consider all engineering features of the problem, but comprehensive and simple forms of agreement must be made. There are many reasons that point to the necessity of adopting a simple, effective and generally applicable policy regarding the use of joint poles. The present-day efforts toward conservation will require the saving of our timber. Many citizens are beginning to consider an excessive number of poles on streets and highways to be as unnecessary as it is unsightly. The same persons want the least expensive service possible from signal and central station companies, and this demands economy in all directions. It will be difficult to make them believe that it is cheaper for those companies to operate over separate pole lines. Furthermore, the commissions representing the public, ascertaining and anticipating its desires, will be taking action toward the settlement of the question. Already such action is under way in many places.

"Therefore it will be advisable for engineers and commercial men to prepare specifications and agreements and work definitely in the direction of joint-pole construction rather than wait for pressure from the outside. It would be well for the companies involved to consider that their reputation as public servants and

the confidence of those whom they serve are in some degree at stake."

TELEPHONE ENGINEER is fortunate in being able to present to its readers in this issue, the complete and practical discussion of this subject presented by Mr. Curran at the Telephone Plant Conference at Purdue University.

MAKING MEMBERSHIP PAY

Every telephone company in the business was benefitted by the recent conference of state telephone association executives.

The inauguration of the inter-association conferences marks a decided advance in the efforts of the state telephone associations to make their operations so definitely profitable to their members that companies not allied to the association in their state will be guilty of woeful neglect of opportunity. The meeting emphasized that a telephone association's success is determined by what it can do for each individual company through the collective force and brain of all the members.

It was the purpose, and the achievement, of the opening conference to schedule association activities that would make non-member companies sit up and take notice. Those companies now belonging to state associations need no further evidence of the practical, substantial value of their membership.

THE TELEPHONE SECURITY MARKET

The recent experience of several telephone companies that have placed on the market issues of preferred stock would seem to dispel any doubts that may have been present as to whether telephone securities could be marketed at the present time.

The latest of offerings is the issue of the New York Telephone Company. This company offered $25,000,000 of 6½ percent cumulative preferred stock to the general public which was oversubscribed in the ratio of nearly three and one-half to one.

More than 107,000 different people, apparently decided that the prefered stock of this corporation represented a safe and desirable investment for their savings and it was necessary to scale down the subscriptions so that no one will receive more than five shares. This will mean that more than 100,000 new stockholders will be added to the list of owners of the telephone business in the territory served by one company alone.

Just who were these 107,000 prospective telephone owners? When the Southwestern Bell Telephone Company marketed its issue of $2,500,000 in preferred stock, a tabulation of the 4,712 individual purchasers showed that they represented 137 vocations in every walk of life. Out of the total only four listed themselves as capitalists and 146 as unemployed so that only 150 people who have no occupation other than that of making investments were included. It is interesting to note that housewives with 692 subscriptions is the largest single class of purchasers.

The lesson to be learned from this is that there is a real market for telephone securities just at the present time and that market is right at home among the people whom the telephone company is serving day by day. We seem to have changed from a condition where no market could be found for telephone stocks to a condition where every person in the community is a potential purchaser of these securities.

Japan's government telephone system recently has installed telephones for 850 people who applied for service in 1907.

New York's telephone company has 104 buildings with a combined floor area of 72 acres.

Joseph H. Thatcher, General Agent of the Pacific T. and T. Co. at Portland, has been given a banquet in honor of his 60th year of service.

About 63 per cent (almost 18,000,000 miles) of the Bell's wire, is underground.

BRUSH TREATING O. K.

Long Service Record Shown in Poles of Nebraska Telephone Company.

Milwaukee, Wis.—Further evidence of the value of brush treatment of telephone poles has been received by the Carbolineum Wood Preserving Co., of this city, makers of Arrow Carbolineum. This testimony is a letter from the Pawnee Telephone Co., Pawnee City, Neb. The utility writes:

May 18, 1922.

"Carbolineum Wood Preserving Co.,
"Milwaukee, Wis.
"Gentlemen:

"In March, 1898, we started to use Carbolineum, applying a heavy brush treatment to all the main poles set down Main Street, and they are standing yet in good preservation.

"We are now removing these poles to place the cable underground and find that the poles will do to use again.

"They are 7-inch top, 45-foot poles and cost us $5.25 laid down at the time. Poles have advanced so that we have made the best investment that we ever made by preserving them as we did."

Ease of application, and long service record, state Arrow Carbolineum's makers, have been the factors responsible for the product's continuous sales growth.

Vermont Holds Second Annual Affair at Chelsea—Lively Convention

Chelsea, Vt.—The second annual meeting of the Telephone Association of Vermont was held July 28th. About one hundred telephone people were present. A very interesting program covered finances, transmission over toll and rural lines, accounting, operating, and public relations. At the business meeting the following directors were elected: C. D. Cushing, Bethel; F. Harding Chesmore, Jonesville; A. W. Foote, Middlebury; C. L. Spear, West Corinth; C. L. Ovitt, Enosburg Falls; F. W. Story, Boston, Mass.; M. W. Hicks, Granville, N. Y. Following the business meeting, the directors organized by electing the following officers: President, C. D. Cushing, Bethel; Secretary-Treasurer, C. L. Ovitt, Enosburg Falls; Vice-President, C. L. Spear, West Corinth; Auditor, F. Harding Chesmore, Jonesville. A very complete exhibit of standard telephone apparatus was made by the Central New Hampshire Telephone Company of Laconia.

Inductionless System

Italian Engineers Develop Telegraph System Immune to Disturbing Currents

By Staff Correspondent

The Administration of the Italian State Railways has applied a new system of single wire telegraph operation to one of its lines which has been subject to disturbances from the railway which has been electrified using 3600 volt, 16.7 cycle, three phase current. The system used on the telegraph lines was described before a session of the International Railway Congress at Rome and Messrs. Enrico Frattola, Vitale Egisto Castelli and Romualdo Regnoni are given credit for its development. The former methods of operation were abandoned and the new system was developed with two conditions in mind: (1) there was to be no attempt made to prevent flow of the disturbing currents; (2) transmission currents and terminal apparatus were to be used that would not be affected by the disturbing currents. The transmission currents selected were of a relatively high frequency compared to the frequency of the power circuit used for traction and the principle of resonance was used to cause the operation of the apparatus without disturbance from the lower frequencies. The frequency employed in the preliminary experiments was 110 cycles but 126 and 150 were adopted for the actual installations. It has been possible to design apparatus that will operate over a considerable margin and still keep the disturbing current below a value that will cause the instruments to operate. This margin permits a considerable variation of the frequency of the signalling current which is necessary when it is obtained from local sources of power.

The high frequency telegraph current may be obtained from a small motor-generator set or may be obtained by doubling or tripling the frequency by the use of static transformers of the saturated core type. The adoption of 126 and 150 cycles was due to the fact that they were easily secured from 42 and 50 cycle, three phase lines that were available. An induction coil with a spring vibrator is installed as a reserve generator.

The circuit shown in Fig. 1 is the arrangement of the receiving apparatus. In the figure, M is a Morse key with five contacts. When the key is depressed the receiving apparatus is disconnected from the line and the transmitting current is sent out either from the Triplicator transformer E or from the auxiliary induction coil B B_1. When the key is at rest the transmitting device is insulated from the line which is connected to the receiving device consisting of a polarized relay R_1 whose armature vibrates and makes an intermittent contact which closes the circuit of the cell P_1. This amounts to increasing the resistance of the circuit and thus diminishes the current supplied by the cell P_1. The relay R_2 releases, which closes the circuit of the Morse apparatus A.

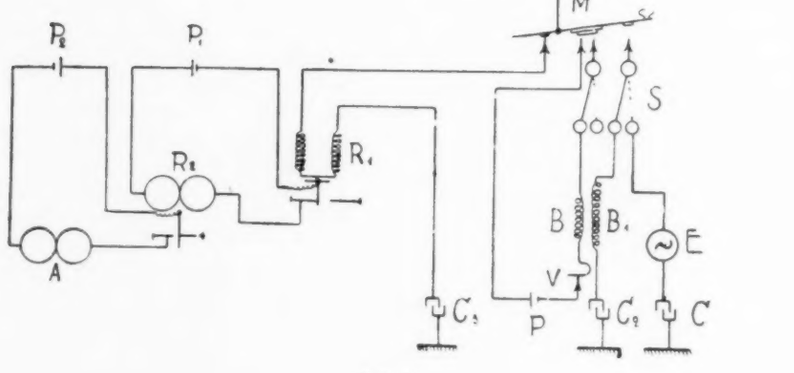


FIG. 1

L L_1 - Line
M - Double telegraphic key
S - Switch with two levers
B B_1 - Induction coil
V - Vibrator
P - Accumulator
C_1 C_2 C_3 - Condensors.
E - Spinelli transformer
R_1 - Polarized relay
R_2 - Ordinary relais.
P_1 P_2 - Cells.
A - Morse apparatus.

Results of Experiments

The General Direction of the Italian State Railways caused a series of experiments to be made to determine the efficiency of the apparatus and its working in practice. These were made on a section of line where the telegraphic circuits were exposed to induced electro-motive forces of considerable duration and higher than 100 volts with maximum points up to 258 volts. With these strong induced voltages clear and undisturbed communication was assured while with ordinary apparatus it was impossible due to trembling of the armature of the printing device. The results of the experiments may be summed up as follows:

1. The system allows regular operation of the ordinary Morse apparatus on one-wire circuit exposed to disturbances.

2. The attenuation of the alternating currents is negligible within the limits of the ordinary length of circuits for railway purposes.

3. Disturbances produced by alternating current telegraph systems in neighboring and parallel circuits do not affect the Morse apparatus.

4. Disturbances in neighboring telephone circuits are, in the cases observed, of the same order as those produced by other telegraph systems when the coil type generator is used but are insensible when a generator with a regular curve is employed.

Telometer Gets Boost in Ad of Big Newspaper

Pittsburgh, Pa.—In increasing its classified advertising, the Pittsburgh Sun is making a drive for business to be telephoned into the paper's headquarters. Illustrating one of its recent advertisements is a telephone with a Telometer attached, which A. M. Crichton of the Measured Service Meter Co. sends TELEPHONE ENGINEER, with the comment that "Coming events cast their shadows before them." Crichton, and his associate in the Telometer enterprise, E. D. Schade, report that their service measuring device is hitting a lively sales pace, and looks due for wide adoption in the near future.

Valuation in Rate Making

Chapter VI—Inventory of Underground Plant—Continued

By Charles W. McKay, Associate Editor

In the July installment, specific and detailed instructions were given as to the inventory of the underground cable and conduit plants. To facilitate a ready understanding, on the reader's part, of these instructions—illustrations are presented, in this installment, accompanied by diagrams and field forms.

In undertaking the inventory of an underground plant, even a small one, a map should be prepared showing the general layout of the conduit system. Among other things, this map should show the location of the central office; the location of all ducts lines; the location of all manholes and the location of lateral, or subsidiary, ducts—extending from the manholes to buildings or poles. An ordinary city map may be used for this purpose—providing it is of large enough scale. A map of the scale of approximately 400 feet to the inch is preferable. If such a map is not available, a sketch should be made, showing the block outlines, the street and alley locations and the manhole, conduit and lateral data—as above suggested.

Figure 10 presents an illustration of such a map. 24 ducts leave the central office, extending to manhole No. 1—the central office manhole. At this point, the conduit system divides—8 ducts extending westward to manhole No. 2, and 16 ducts eastward to manhole No. 22. It will be noted that 2 lateral ducts extend from manhole No. 2, one to a pole and one to a building. The 8 duct conduit line continues westward to manhole No. 3, and beyond. The 16 duct conduit line terminates at manhole No. 22—8 ducts extending southward to manhold No. 10; 6 ducts northward to manhole No. 49, and 4 ducts eastward to manhole No. 23. A lateral conduit extends from manhole No. 22 to a pole located near the southwest corner of Second St. and Avenue B.

In some instances it is advisable to locate the manholes exactly—in other words, to give the distances between the center of the manhole cover and the respective curb lines. In Figure 10, it will be noted that manhole No. 22 is located 5 feet south of the northerly curb line on Second St., and 4 feet west of the easterly curb line on Avenue B. It is not necessary to indicate the kind of paving, the distances between manholes or distances from manholes to lateral risers, on the map—as all of this data is provided for in the field form illustrated in Figure 11.

Before taking up a detailed discussion of Figure 11, it may be well to caution the reader with respect to two points—points which have often caused trouble in the recording of underground inventory data.

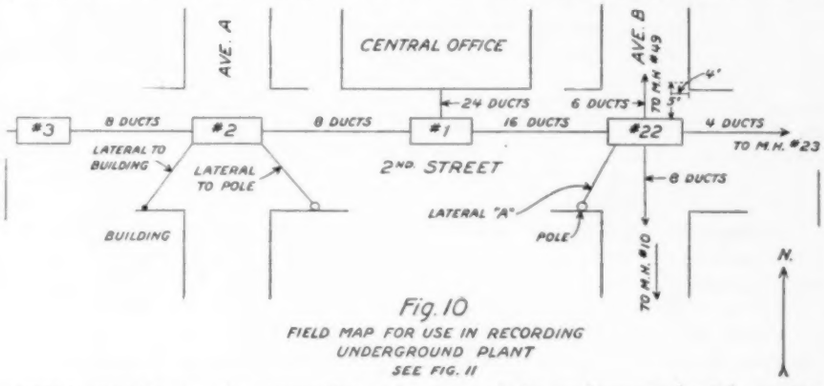


Fig. 10
FIELD MAP FOR USE IN RECORDING UNDERGROUND PLANT
SEE FIG. 11

It sometimes happens that the central office manhole (the manhole immediately adjoining the central office) is built in connection with, and is really a part of, the central office building structure itself. In cases of this kind, the cost of the manhole has been included in the cost of the building and—to avoid duplication—the manhole should not, of course, be inventoried as a part of the underground conduit system. In such cases, it frequently happens that instead of having ducts between the manhole and the central office—a passageway, or tunnel, will be provided, the cables being "racked" on the side walls of this passageway.

Another caution, in connection with the inventory of the underground plant near the central office—many appraisal engineers make the mistake of assuming that the underground cable proper (exchange account No. 245 and toll account No. 255) ends at the "pot-head" splice, which is usually located in the basement of the central office. From the pot-head splice to the main frame, it will usually be found that a number of smaller (silk or cotton insulated) cables extend. A 600 pair underground cable, for instance, may be "pot-headed," in the basement of the central office, and from the pot-head splice to the main frame there may extend three 200 pair, silk or cotton insulated "central office terminating" cables. These central office terminating cables are a part of the underground cable system (Exchange Account 245 and Toll Account 255) and they must be recorded as a part of the underground system—rather than as a part of the central office equipment—to conform with the instructions of the Interstate Commerce Commission—or the local state commission, as the case may be.

Figure 11 illustrates a field form for recording the underground plant. The illustration has been made as simple as possible—so that the reader may readily grasp the fundamental principles underlying this rather complicated part of the inventory task. It is assumed that the work is being done by a two-man gang—one experienced appraisal engineer and a helper. It is further assumed that these men have completed the inventory of the central office manhole—manhole No. 1. With the aid of a steel tape, preferably of 100-foot length, and surveyors' pins, the men will measure the

distance from the center of the cover of manhole No. 1 to the center of the cover of manhole No. 2. This measurement will be recorded at some convenient place on the margin of the form—for future reference. As the men make the measurements, they will note, carefully, the kind of pavement existent between manholes No. 1 and No. 22, and the pavement around manhole No. 22.

Referring to Figure 11, it will be noted that a diagramatic picture of the manhole is presented at the upper right-hand corner of the illustration. It has been assumed that the four walls of the manhole have been laid down in a horizontal position. The small squares indicate ducts, and the small squares bounded by a heavy line, indicate the ducts as found in the manholes—and the form in which they are built up. It will be noted that 16 ducts enter the manhole from the west, probably built up of four 4 duct multiple tile; 6 ducts leave the manhole to the north—one 6 duct multiple tile set in a vertical position; 8 ducts leave the manhole to the south—two 4 duct multiple duct tile (one laid on top of the other) and 4 ducts leave the manhole towards the east, composed of one 4 duct multiple tile. One lateral conduit leaves the manhole, in a south-westerly direction — terminating at the pole on Second street, near the southwest corner of Second street and Avenue B.

With respect to the cable—a 600 pair cable enters the manhole from the west (from manhole No. 1); this cable is spliced and "stubbed" on the northerly wall of the manhole; a 400 pair cable extends east; a 200 pair cable extends north and the stub is of 200 pair capacity. On the end of the stub there is spliced a 100 pair lateral cable—extending (to the lateral above mentioned) to the pole near the corner of Second street and Avenue B.

Reviewing the form in detail—and the method of procedure—adopted by the appraisal engineer and his assistant, the first step will be to note the manhole number in the space provided in the upper left-hand corner of the form. The central office district should be also noted—in the space provided therefor.

The first item under "Conduit" provides for the recording of the duct trench length. The engineer has already obtained the distance from the center of the cover of manhole No. 1 to the center of the cover of manhole No. 22. We will assume that this distance is 308 feet. If the covers are located in the exact center of each of the manholes, and if each manhole has a length dimension of 6 feet, we will have a deduction of 3 feet for each manhole, or a total of 6 feet. This gives a total duct length of 302 feet.

In connection with the study of Figure No. 11, it must be remembered that the engineers are working from (not toward) the central office. Hence, they will record **detailed** data as to conduits and cables—only for the section between manhole No. 1 and manhole No. 22—in their inspection of manhole No. 22.

"Sixteen ducts" will be entered under "Size of Subway." This 16 duct subway is composed of four 4 duct multiple tile and, under the heading, "Material," the engineer will note the following "multiple duct (4)." It is assumed that the paving has been found to be concrete.

Under the caption, "Manhole," the material of walls is found to be brick; the material of the floor is found to be reinforced concrete and the material of the roof is also reinforced concrete. Each of the above items is noted in the spaces provided therefor.

On the side walls of the manholes there will be found "racks" or "strips" for supporting the cables. In this case two such racks are found.

The dimensions of the manholes are noted on the manhole diagram. Manhole No. 22 is found to be 6 feet long (interior dimension); 4 feet wide and 6 feet high to the roof of the manhole. The "neck" of the manhole is found to be 3 feet deep, in other words, there is a distance of 3 feet between the roof of the manhole and the street level.

Under the caption "Laterals" it will be noted that, in the case cited in the illustration, there is only one lateral. If a number of laterals are found, it is well to number, or letter, them. In the present case, we have designated the lateral by the capital letter "A." It will be noted that the length is found to be 125 feet from the manhole to the beginning of the "riser." The significance of the term "riser" and of the dimensions referred to herewith will be pointed out more clearly in connection with Figure No. 12. The paving is found to be concrete and the riser itself is of 3-inch

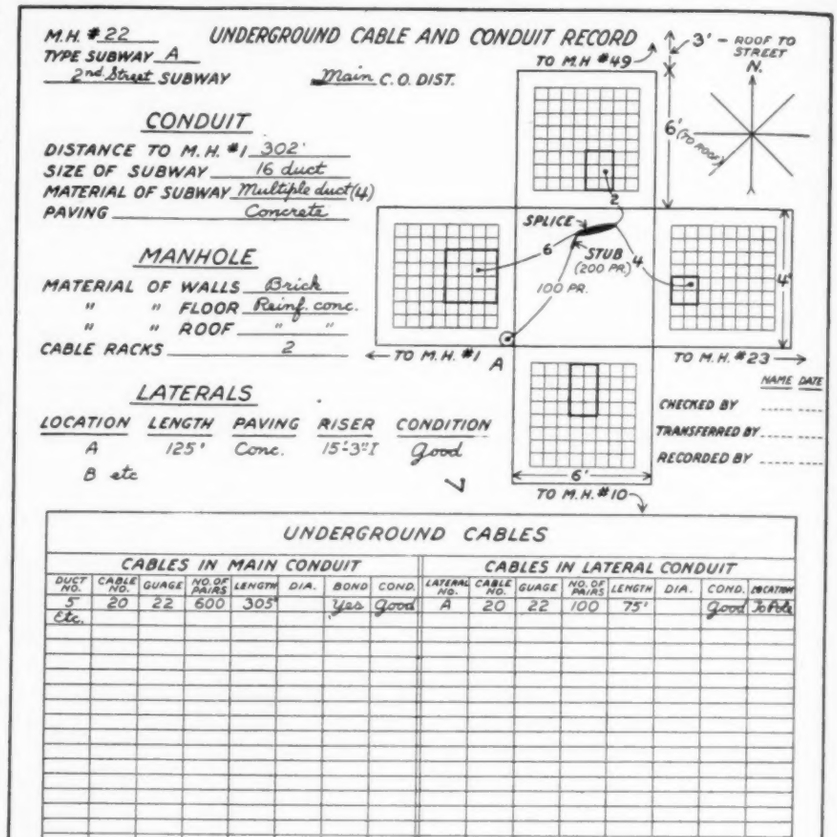


Fig. 11

FORM FOR RECORDING UNDERGROUND PLANT.

iron pipe, 15 feet long, all in good condition.

In considering the portion of the data form entitled "Underground Cables," it should be remembered that we are considering, only, the data (in detailed form) for the section between manhole No. 1 and manhole No. 22. Hence, although we indicate the other cables, we record only the data pertinent to the 600 pair cable, entering the manhole from the west. This cable is located in duct No. 5; is designated as cable No. 20 (cables are usually tagged with a small brass plate bearing the cable number); the cable is found to be of 22 gauge wire; there are 600 pairs and the length is 305 feet. In determining this length it has been assumed that the splice in manhole No. 1 is at, or near, the easterly wall of the manhole, and that there is 3 feet of slack (for purposes of attaching the cable to the manhole wall) between the westerly wall of manhole No. 22 and the splice. In view of the fact that measurements are taken from splice to splice, 3 feet is added to the duct length (302 feet) giving a cable length of 305 feet. The next column is entitled "diameter." Cables of a given make, gauge, pair, size and capacity, have a uniform diameter. Hence, by measuring the diameter, the engineer can often ascertain the size of the cable. There is a device on the market known as the "strap gauge," which can be wrapped around the cable and by means of a scale, the diameter in inches—or fractions thereof—may be read directly. On the reverse side of this same strap gauge, there is a scale which will enable one to obtain a direct reading as to the circumference of a cable in inches. A gauge of this kind is a great help to the engineer—in the recording of underground cable data. Especially in the case of old telephone plants, cables of miscellaneous size and gauge are frequently found, and—as frequently happens—if the records in the office are not clear, it is often hard to determine the size and gauge of such cables. Knowing the make of the cable, however, and with the aid of a strap gauge, the engineer can determine the size and gauge with a remarkable degree of accuracy.

Great caution should be observed in determining sizes and gauges of cables. A 300 pair 19 gauge cable has very much the same external appearance as a 600 pair 22 gauge cable—but obviously, there will be a great difference in the splicing cost incurred in connection with the initial installation. For this reason, and for many others, it is important that the size and gauge be determined accurately. In questionable cases, the following procedure is suggested—if office record data, and the results obtained by the use of the strap gauge are not conclusive, determine the date at which the cable in question was installed. Try to find some splicer who was in the employ of the company at that date—and who either worked on the cable or knew about its installation. Obtain such data as you can from him, and if possible, go through the warehouse and junk pile and see if you cannot find a similar piece of cable. Strip the sheath from a short section of this cable, gauge the wires, count the pairs and measure the external diameter. Take this section with you—to the manhole where the questionable cable is located—and compare the sample with the working cable.

The last column under the caption "Cables in Main Conduit" is entitled "Condition." The condition should be noted at the time of recording the inventory — but for the reasons discussed in previous installments — we will postpone our consideration of "condition and present Value"—until we have had an opportunity to review the theory of depreciation and its practical application to telephone valuation problems.

The next eight columns on the underground cable form are entitled "Cables in Lateral Conduit." The first column is for recording identification data as to lateral cables—in this case, capital letter "A." The next column is for the cable number—of which this particular lateral is a branch. The next three columns provide for the gauge, number of pairs and length, respectively, of the lateral cable in question. The following column provides space for the recording of data as to the diameter and the last two columns are for the notation of data as to the condition of the cable and its location—whether it is extended to a pole or to a building.

In connection with the study of the data pertaining to laterals—it may be well to referto Figure 12. This figure shows a cross-sectional view of a lateral extending from a manhole to a pole. It has been assumed that the lateral is constructed of fibre, or clay conduit, up to the point "a." From point a to point b we have a 3 inch iron pipe riser. The measurement is taken from the manhole wall to the base of the pole, but a subsequent deduction is made, and a readjustment to figure the amount of clay or fibre conduit and the amount of iron pipe underground. The "riser" ends at the point "b."

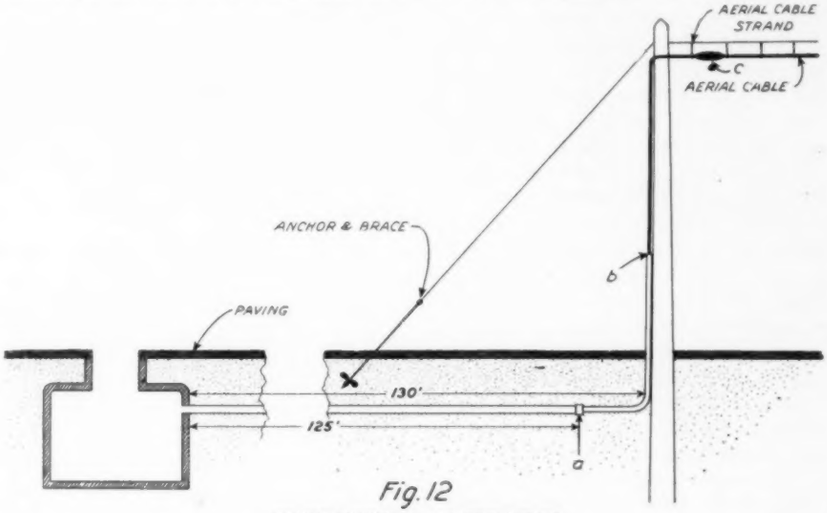


Fig. 12
CROSS-SECTION ILLUSTRATING LATERAL FROM MANHOLE TO POLE

In connection with Figure 12, it may be well, also, to consider the distinction between aerial and underground cables. If there is no terminal box (in which the underground cable terminates) all of the cable will be considered as underground up to the splice on, or near, the first pole. In Figure 12, the splice is indicated at "c." Cable beyond this point is considered as aerial cable. If there is an underground terminal on the lateral pole—the cable will be charged to the underground cable account (No. 245) up to the terminal. From this point on, it will be charged to aerial the cable account, (No. 242 for exchange plant, and No. 252 for toll plant). Great care should be exercised in distinguishing between **aerial cable terminals**, located on lateral poles, and **underground cable terminals**. The aerial cable terminals—located on underground poles, may be readily distinguished due to the fact that they terminate in a horizontal splice —the splice between the underground and the aerial cables.

Again referring to Figure 11—we may summarize as follows: Record all data, as to conduits and cables, for the subway section between the manholes you have just completed (in this case manhole No. 1) and the manhole in which you are now working (in this case, manhole No. 22). Record all manhole data—on the forms—for the manhole in which you are working. Indicate—but do not record in detail—data as to conduits and cables, leaving the manhole in directions, other than the one which you have just traversed (in this case, the section between manhole No. 22 and the next manhole toward the central office, manhole No. 1). Record in detail all data as to lateral conduits and lateral cables.

At this juncture, it may be well to add a word as to the necessity for extreme caution in inventorying the underground plant. When the work is completed in one manhole—place a check mark opposite this manhole on the field map (Figure 10) and be sure that all of the contiguous manholes are visited. For instance, in the illustration presented in Figure 11, it will be noted that six ducts leave manhole No. 22 in a northerly direction. At the top of the diagram, there is a note "To Manhole No. 49." Before completing any section of the underground cable plant, be sure that all of the manholes have been visited. In the case in question, the engineer should refer to the field map; see where manhole No. 49 is located and be sure that not only the manhole itself has been inventoried, but that all data has been recorded for the section lying between manhole No. 49 and manhole No. 22. The necessity for this precaution will be obvious to the reader, when it is remembered that a relatively large amount of money is tied up in the underground plant of a telephone company. The omission of a few sections of subway systems may result in an appreciable lowering of the total physical value of the company whose plant is being appraised. The writer lays a special emphasis upon these facts—because he has known of instances where a number of manholes, and a number of sections of subway, have been entirely omitted from the inventory and appraisal—due to carelessness on the part of field men in "cross-checking" their work. It is also well to watch out carefully for what is known in telephone parlance as "dips." In connection with aerial cable runs, it often happens that unusual conditions warrant the installation of several sections of underground system—with possibly two or three manholes. In some cases, installations of this kind are necessary to provide for crossings under railroad tracks—or low railroad bridges. It often happens that these isolated sections of subway are not clearly indicated in the company's records of underground plant and unless the field men are alert, such sections are liable to be omitted from the inventory and appraisal. The writer knew of an instance, several years ago, where some eight or ten manholes—with adjoining conduit sections—were entirely overlooked in the appraisal of a telephone plant serving a city having a population of several hundred thousand. All of the manholes, and subway sections, in question, were isolated and used in connection with railroad crossings.

As suggested in the last paragraph of the July installment, the subject of interior block cables, and house, or building, cables, will also be discussed in this issue. To quote the language of the "Uniform System of Accounts," as prescribed by the Interstate Commerce Commission: "It (account 245) should include, in addition to the main exchange, underground cable, and subsidiary cables to laterals, to poles or building terminals; the subsidiary cables to the interior of city blocks for connection with interior block wires; and the subsidiary cables entering vertically—as house cables—into buildings for connection with the inside wires.

"House cables are considered to be vertical extensions of underground cables or plant similar thereto. They do not include the inside wires extending from the terminal boxes of house cables to subscribers' stations, nor the cables for subscribers' private branch exchange switchboards, which are included in account 232, Station Installations."

In the smaller cities and towns, the inventory of the interior block cables is a comparatively simple problem—but it is a very difficult one in large cities like New York and Chicago. In the city of New York, vast areas are entirely served by interior block cables, attached to rear yard fences. In cases of this kind, it is necessary for the appraisal engineer to make an inspection of each city block. It will usually be found, however, that records, in blue print form, are available, showing the exact location of all cables and terminals on rear yard fences, and along rear building walls. In such cases, the blue prints may be checked at intervals to ascertain the general accuracy of the data involved, and all measurements and other data obtained from the office records or by scaling the blue prints.

In the smaller cities and towns—despite the fact that a comparatively small amount of block cable plant is involved—it is well to inspect the block cables and to record all data in detail, if only for subsequent record purposes.

Where time is an important factor—and accuracy of detail is not required—it is sometimes possible to make an inspection of a number of blocks and from the resultant data to obtain an average unit cost per block—this unit cost to be applied to the total number of blocks containing block cables. This method, however, is not advanced—except in extreme cases.

The problem of inventorying house cable plant is not as difficult as the reader may imagine. House cables are not prevalent except in the larger towns and cities—and in these cases, it will be found that the companies usually have an accurate maintenance record for each office building or hotel. In view of the fact that the cables are usually concealed in conduits within the building walls—or in shafts—a detailed inspection, of course, is out of the question. The engineer should obtain all possible data from the company's record department and make enough field observations to insure the accuracy of this data. In the smaller towns, it will usually be found that not more than one or two buildings are equipped with house cables, and for record purposes, it may be well to inspect these house cables in as much detail as is possible.

Submarine Cable

The inventory of the submarine cable should include the cable, the cable towers, loading coils, cable boxes, fittings and any other materials used in the installation of submarine cables. The final inventory should be so summarized as to show the major items by classification, quantity and size. No particular field form is required for inventorying submarine cable plant. A diagram, or sketch, with a complete list of all the materials is all that is necessary.

The diagram, or sketch, should give the name of the stream and should clearly indicate the geographical location of the terminal points, and the probable routing of the cable across the stream — or rather under the stream — with measurements. Of course it is impossible to measure a submarine cable accurately in the field. The total length may usually be obtained from the office records. If such records are not available use

the following method is suggested: Take a piece of cross section paper and plot the width of the stream as accurately as possible. From the best available records, obtain the maximum depth of the stream, and then draw a curve which represents to the best of your judgment, the probable "lay" of the cable, in the bed of the stream between the terminal points. Scale off this curve, and you will have at least an approximation of the total length of the cable.

In connection with submarine cables, especial attention should be paid to the recording of data as to the type of armor and the number of wrappings and gauge of wire used in making up this armor. The circumference of the lead sheet (under the armor) should be recorded and also the total circumference of the armored cable—including the armor.

Another point to be ascertained, if possible, is whether the bed of the stream was dredged in connection with the laying of the cable — or whether the cable was merely laid upon the surface. Obviously, there is a great difference in the cost of laying submarine cable on the surface of the bed of a stream—and the cost of dredging a "slot" for the cable. In some cases, underground conduits are laid for submarine cables. In such instances, all data as to the conduit system should be noted in detail, and this data segregated from the cable data, and charged to conduit account instead of to the cable accounts.

Still another point to be noticed is the method of anchoring the ends of submarine cables. Sometimes, rather elaborate structures are necessary in connection with the cable anchorage. All terminals, loading pots (or coils), terminal apparatus, potheads, splices, grounds, bonds or other special equipment, used in connection with the installation of a submarine cable, should be recorded. These data should be properly classified as to numbers, kinds, quantities and specification or code numbers.

We have now practically completed the consideration of methods of inventorying of the outside plant. In closing this chapter, it may be well to again call the reader's attention to the necessity of making special provision for the segregation of exchange from toll plant and for the proper proration of such plant between exchange and toll, where the plant is used jointly for exchange and toll purposes, as in the case of "composite" cables having a core of 13 or 16 gauge wire used for toll purposes—this core being surrounded by 22 gauge wire utilized for exchange purposes.

Another point which should receive the reader's most careful consideration, is the necessity for extreme care in recording the inventory of all of the component elements of outside plant. Inventories and appraisals, that are used for rate purposes, are usually carefully checked by the engineers representing the state commission—and sometimes by engineers representing opposing factions. Mountains are sometimes made out of molehills—in connection with the inventory of the outside plant. The writer has known of instances where long and exhaustive arguments have taken place between opposing counsel with respect to the location, ownership, or use of pole lines. Frequently such arguments result in a demand for a recheck of certain portions of the plant. Obviously, such re-checks are expensive, and, if the field work is done carefully, in the first place, they are rarely necessary.

MICHIGAN CUT ORDERED

Commission in Decision Hits Bell Contract—Allows No Interest On Reserve

Lansing, Mich.—In a decision featured by the completeness with which it covered the legal aspects of public utility rate legislation, the Michigan Public Utilities Commission ordered a reduction in the rates of the Michigan State Telephone Co., amounting to $1,125,000 a year, $1,000,000 of which applies to Detroit.

Slight increases were granted in the class rates at various points.

The reduction was ordered after consideration of the Michigan State company's plea for an increase, and has been appealed by the utility.

Bell 4½ Per Cent Contract Void?

A cut of the American Telephone and Telegraph Co. income from $2.30 a year per subscriber, to 90 cents, was ordered by the commission, it saying that "under the law of this state the 4½% Bell contract is at least presumptively void". However the commission added that superiority was generally conceded the transcontinental and intrastate toll systems of the Bell, and "it would be manifestly unfair to exempt the toll system from the burdens of the 4½% contract, by allocating its burden solely on a station basis."

Cities of approximately the same size and having the same general telephone conditions are placed in a group, the same rate to govern all cities.

No return is allowed to be earned on the depreciation reserve, according to the commission ruling, it contending that since the public has provided the money that is in the depreciation reserve, it should not be called upon to pay a return on its own investment in the telephone property.

"A dignified guess" is the appellation the commission hangs onto the cost of reproduction new, less depreciation, method of valuation. Book value also is unacceptable to the commission as a valuation basis. A large part of the price period considered in obtained the 10-year average appraisal was a period of inflation, the commission recites. Stock watering during the reorganization also is alleged by the commission.

What Makes Good Service

In its statement the commission says: "What constitutes satisfactory telephone service is determined by the telephone using public, who want among other things, a quick response, accurate operation, knowledge that the calling party is being signalled, a clear tone, freedom from interference, prompt disconnect, quick recall and courteous treatment. It is immaterial with what equipment or by what organization these things are given. * * * It seems to be settled that there are now available manually operated switchboards and apparatus, and operating methods which permit reductions in labor costs, in exchanges of over 2,000 lines, by the addition of facilities or features that eliminate the widely varying load factor on different operators' positions and which create a uniform load condition".

The commission was uncertain as to whether or not the decreased operating expense of contemplated new equipment would be more than counterbalanced by the high initial investment, and said: "if proper changes in, and additions to, the present equipment are made there will be no precipitate retirement of installed plants".

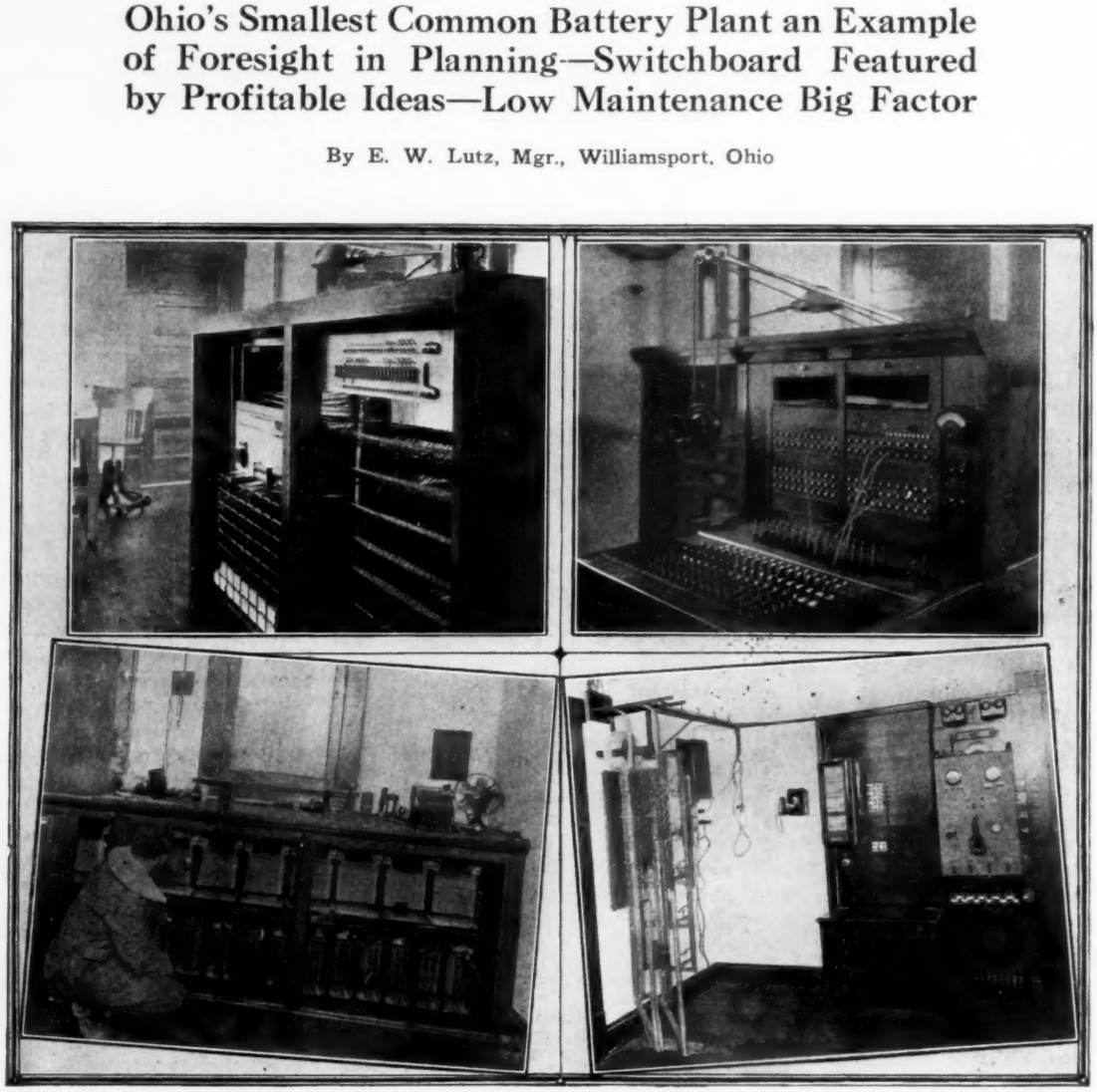
"The investment of private capital in a public utility enterprise is not underwritten. * * * The value of property for rate purposes should be measured by its capacity for economic use", outlines the commission in stating the foundation of its decision.

War's aftermath developed in the commission's reference to the fact the extension during the unprecedented development at Flint, Mich. at the time of the price peak, was made at the insistent demand of citizens and the commission, and "it is doubtful if this installation is presently worth what it cost".

Efficiency in Small Exchange

Ohio's Smallest Common Battery Plant an Example of Foresight in Planning—Switchboard Featured by Profitable Ideas—Low Maintenance Big Factor

By E. W. Lutz, Mgr., Williamsport, Ohio



Upper Left: Where the Cables Terminate. Upper Right: Kellogg Switchboard at Williamsport. Lower Left: Giving the Batteries the "Once Over." Lower Right: Power Apparatus

Williamsport, Ohio.—When replacing the central office equipment of a telephone exchange there are two results that should be obtained—better service and more economical operation.

If it be an exchange of possibly two or three thousand stations, these points would be very carefully considered. New types and special features would be investigated and the decision would be a switchboard that would be up to date in every respect.

Is the same true when purchasing equipment for the small exchange of possibly two or three hundred stations? In most cases, I should say not.

In times back, the magneto service with code ringing was all that was known for that size exchange and when time for replacement came it was decided without much thought, that the same type equipment was good enough for the future.

We all expect the station connected on a small exchange to pay a reasonable return on the investment, as well as the one connected on the larger exchange. This being true, they should be served with a system that is just as up to date as is possible to make it.

For these reasons, we decided to install a Kellogg Universal switchboard in our Williamsport exchange, which is operating 285 stations, and to place on the board all features and conveniences that would be practical on a board of this size.

In our minds there never was any question from the standpoint of service with this type of switchboard, but there was some question as to being able to show economies in operation that would justify the additional cost over the straight magneto type.

Each can best prove this for himself by taking the battery maintenance on switchboards, ringing machines and magneto telephones and comparing this with the cost of generating current for a storage battery with a small gas engine outfit. In addition

to this, at least all future stations can be installed with common battery telephones with the saving of first cost in this type over the magneto.

It had been our plan to install this board in place of the old, leaving all stations magneto until after the cut-over and then change one line at a time to common battery. These plans were changed, because of outside plant conditions being such as to require rebuilding.

We installed underground cables instead of open wire leads and common battery telephones in the entire village, thus making Williamsport, so far as we are able to ascertain, the smallest town in Ohio, having common battery telephone service.

Rural lines are still being operated magneto, so we are able to fairly judge the operation of the type of switchboard under both conditions. We believe the Universal switchboard to be the most practical for small exchanges.

Williamsport's Features

The following is a list of all special features and other little conveniences which have been installed at Williamsport:

A release key is installed in the left hand blank panel of face of board, to release signals on the magneto lines when a number of them have been brought in by lightning.

Arrangement of indicators on left hand side of jack so as not to interfere with the jack number and show the loading of party lines.

A bank of lamps connected with all fuses and heat coils so as to give a signal at the switchboard if either is blown.

Individual jack for booth line, where no incoming signals are required, arranged with extra contacts for operating a relay which lights an electric light in booth when plug is inserted in jack.

An individual jack for cord tests, and converter test with test bells.

Push button keys for operating electric locks on doors. Doors into the operating room are permanently locked from the outside, but never from the inside. When admittance from the outside is desired the operator can unlock them from the board.

The voltmeter has associated keys and plugs arranged to test for grounds, shorts, crosses and opens on lines.

The converter is kept running only during the ringing operation, and is so arranged that pushing any of the four-party or straight line ringing keys will start it. Slow acting relays are used to keep the convertor in operation for about 30 seconds after the ringing key is released, thus insuring a steady source of ringing power where code ringing is required.

The power board is arranged to care for the charging and discharging of both the telephone and lighting batteries. It is also arranged that in case of a break-down in the power plant the 32-volt lighting battery can be used through proper resistance to operate switchboard, thus insuring sufficient battery capacity to operate the exchange, at present discharge rate, for at least ten days, even though the breakdown be at the most inopportune time.

For convenience in repairing and testing telephones at work bench, we have installed a combination of keys, giving all ringing frequencies, a common battery and a magneto line to the switchboard and a series lamp test cord.

Mr. Lutz, Miss Lulu Lisle, Operator, and the Kellogg Universal Switchboard

GOVERNMENT'S RADIO HEADS

Announce Department Men on Advisory Committee on Radio Broadcasting

Washington, D. C.—At the request of the Secretary of Commerce, Government Departments have appointed representatives on an Interdepartment Advisory Committee on Government Radio Broadcasting. The membership of the committee is as follows:

Agriculture—W. A. Wheeler, Radio Development Section

Commerce—Dr. S. W. Stratton, Director, Bureau of Standards.

Interior—O. P. Hood, Chief Mechanical Engineer, Bureau of Mines.

Justice—S. Ely, Chief Clerk.

Labor—A. E. Cook, Office of the Secretary.

Navy—Com. D. C. Bingham, Naval Communication Service.

Post Office—J. C. Edgerton, Air Mail Division.

State—W. S. Rogers, International Communications Conference.

Treasury—L. J. Heath, Public Health Service.

War—Maj. Gen. G. O. Squier, Chief Signal Officer.

Chief Co-ordinator—Capt. H. P. Perrill, Assistant Co-ordinator, Bureau of the Budget.

U. S. Shipping Board Emergency Fleet Corporation—F. P. Guthrie, head of Radio Division, Operating Department.

The Chairman of the Committee is Dr. S. W. Stratton and the Secretary is J. H. Dellinger, Chief of the Radio Laboratory, Bureau of Standards, Department of Commerce.

The Committee has made a preliminary classification of the kinds of material which the several Departments may have to broadcast by the primary stations, viz., market prices and data, weather and hydrographic news, standard radio signals (such as wave length and time signals), executive announcements, statistics, and educational material. One of the functions of the Committee is to advise regarding priority of the types of Government material to be broadcasted and regarding schedules of operation.

The Committee has recognized the principle that radio must be used primarily for types of service that cannot be as satisfactorily given by other means of communication, and that therefore radio broadcasting should not be used in general where wire telegraphy or telephony or printed publication would be as satisfactory. It is possible that the scope of the Committee's activities may be extended beyond the subject of broadcasting, and that the Committee will act in an advisory capacity to the Secretary of Commerce in matters of Government radio regulation and will consider all radio questions of interdepartmental interest.

Baltimore, Md.—Extensions and repair budget of the Chesapeake & Potomac Telephone Co. for Maryland entails an expense of $673,000 this year.

State Association Heads Meet

First Conference Unites States for Improvement of Association Work—District Meetings in Full Sway in New York, Texas, Pennsylvania and Oklahoma Cities

St. Paul, Minn.—Eight state telephone associations were represented at the first conference of state organization executives, held here July 21 and 22 at the St. Paul Hotel. Tangible evidence of the value of a meeting of this character so impressed those attending, that another conference of state executives was slated for the Independent convention in Chicago this autumn.

Work of the conference fell into two major divisions; getting a man who is not naturally an association man, interested in association work, and handling the affairs of the association's members in a practical and profitable manner.

Some interesting testimony concerned the percentage of telephone companies within the respective states that were represented by the various associations. According to estimate, the Illinois association's membership represented 96 per cent of the telephones in the state, Minnesota has 169 of the state's 366 operating companies, South Dakota's company membership runs about 4 per cent, New York's Up-State association has about 75 per cent of the total companies, Iowa has about 70 per cent of its possible company quota, and Kansas has about 73 per cent of the companies in its territory.

District meetings, its was found, have worked out well with every state association conducting them. The frequent and intimate interchanges of experience have enabled those attending the smaller affairs to quickly and correctly apply the knowledge of their fellow workers.

Operators' Schools Big Help

Operators' schools also have been valuable features of state association activities. They help in building association membership and aid the good will campaigns of the states' telephone companies. According to the experience of the Illinois association, it has been found good policy to hold the district meetings in towns where it is advisable for a company to have additional publicity. In New York, the district meetings are held in summer resorts centers as a usual thing during the summer. Cities where there are strong Independent companies are favored for the district sessions.

Association help in tax problems, and in commission cases, to judge from the stories related at the St. Paul affair, have made the organizations definitely profitable factors in the conduct of almost every company holding membership.

A significant remark was made by President F. B. MacKinnon of the national Independent body, who said: "If the time has arrived for a national telephone Association, instead of an Independent national organization, then the time has arrived for a discussion of co-ordination of state and national associations."

Team Work with Manufacturers

In response to President MacKinnon's request for a statement of the relationship of the associations with the Independent manufacturers, it was unaimously "Resolved, that it be the sense of this meeting that the fullest possible co-operation be given by the several state telephone associations to the manufacturers, jobbers, and dealers in Independent telephone equipment and supplies, and that the officers of the United States Independent Telephone Association be requested to arrange that a committee be appointed to confer with representatives of the manufacturers to determine how much increased co-operation may best be extended."

Legislative Influence

Methods of enlisting legislative help in inductive interference matters were considered and reference was made to the lack of uniformity. Restriction of commission authority in some states, so that it does not apply to power companies has complicated matters.

J. C. Crowley, secretary of the Minnesota Telephone Association, arranged for the first of these meetings which are destined to figure prominently in the telephone industry. The Tri-State Telephone and Telegraph Co. acted as host to the executives, in its characteristic hospitable way.

Get Together on Rates in New York

Cooperstown, N. Y.—Promotion of uniform rates was one of the important and tangible achievements of the first district meeting of the Up-State Telephone Association of New York, held here recently.

Embarrassment and loss is to be avoided by the adoption of the plan, which already has been successfully employed in other Up-State districts.

Uniform rates are to be established for each class of service. Service is being classified as follows:

Class A: Complete metallic circuit, with continuous circuit. Class B: Complete metallic circuit with day service only, and a few hours on Sunday. Class C: Grounded circuit, or mixed circuit, with continuous service. Class D: Grounded circuit, day service only.

A uniform schedule of charges, also was suggested, to be:

Installation, $3.50; Outside move, $3.50; Inside move, $1.50; desk sets, $3.00 a year extra; extension bells, $2.00 a year. Wire mileage outside of free exchange area is to be charged at $6.00 for each quarter of a mile or fraction thereof.

Miss Lulu B. Arnold, Superintendent of Traffic of the Otsego and Delaware Telephone Co., spoke, in interesting detail, of the agency plan of the O. and D. company.

Successful Agency Plan

The agency plan has been adopted in the smaller exchanges where the number of subscribers is insufficient to warrant a force large enough to insure satisfactory attention to the traffic, and give the quality of service

that the subscribers are entitled to.

Miss Arnold said that where an exchange is operated on the agency plan, the company leases the premises, installs the switchboard, and furnishes all labor and material required for the maintenance of the central office equipment. The premises required for this method of operating must contain a large operating room on the ground floor with ample space for pay station booths, and sufficient room to accommodate the patrons who may call at the office. The house also contains living rooms, which can be furnished for housekeeping.

A mature woman of good character is secured for the position and resides in the living quarters with her family. The dwelling portion of the premises is given to her free as a part of the consideration for services, and in addition to this, she is paid a certain commission on the gross amount of business done by the exchange. The agent is made responsible for the quality of the service, which is continuous. The most desirable agent is a widow with a small family, who will realize the responsibility of her position, and appreciate employment where she can remain at home and earn sufficient to provide a good living for her children. If she has a grown-up daughter to act as Relief Operator, it is of material help to her, and if not, it is necessary for her to employ a girl in the neighborhood to act as Relief Operator and take charge of the board when she is unable to do so.

Accounting Important

E. A. Goodrich, auditor of the O. and D., stressed the importance of all departments supplying the accounting department with all information required by the reports that must be submitted to the various regulatory and tax bodies. He explained in detail the successful system that has been operating in his own company.

About 50 members attended the district confab, which had H. W. Fluhrer, Vice President and General Manager of the Otsego and Delaware Co., as its presiding genius. George R. Fuller of Rochester, President of the association, D. C. Cox of Syracuse and J. G. Ihmsen, General Manager of the association, were among the other featured speakers at the meeting.

Other Up-State district meetings will be held at Alexandria Bay in August and at Lake Chautauqua in September.

PENN DISTRICT MEETS

Western District Holds Three Day Instructive Sessions— Well Attended.

Conneaut Lake, Pa.—Attended by 150 alert telephone men and women, the western branch of the Pennsylvania State Telephone and Traffic Assn., held one of its most successful meetings here, July 20-22.

The officers of the Western Branch present are: E. B. Schade, general manager Johnston Telephone Co., president; K. B. Schlotte, manager Kittanning Telephone Co., secretary; John H. Wright, manager Jamestown Telephone Co.; Wm. S. Paca, manager Petroleum Telephone company, and John Z. Miller, general manager Mutual Telephone Co., of Erie, directors.

The opening address was made by O. A. Black, general manager Peoples Telephone Co., of Butler, on "Commissions and Omissions of Telephone Companies." In the evening there was a wireless telegraph demonstration. Addresses were delivered by Mr. Paca, of Oil City, by W. S. Vivian, of the Automatic Electric Co., and by Edw. I. Pratt, advertising manager Kellogg Switchboard & Supply Co., each of these being illustrated by moving pictures.

An address on "The Value of a Service Engineer" by Mr. W. H. Wilson, general manager Clearfield and Huntington Telephone company, followed the recommendation by Mr. Paca, chairman of committee of service engineers that one be employed for the territory represented, an assessment being made upon the companies in proportion to units in service.

Two addresses, "Operators' Problems" and "Qualifications," by Mrs. Sylvia Eldredge, chief operator, Albion and "The Value of System" opened the operators' school conducted by W. S. Vivian.

Friday morning papers were read on the "Responsibility of Recording and Filing Tickets," by Miss Millian Brent, of Kittanning; on "The Duties of the Toll Center," by Miss Ruth Kittlinger, chief operator, Kittanning; on the "Duties of the Recording and Line Operator," by Miss Mabel Pearson, chief operator, Jamestown, and on "Overlapping—Team Work and Co-operation," by Miss Charlotte Reott, of Butler. At the afternoon session the papers were on "Different Kinds of Toll Calls," Miss Marion Lacey, chief operator, Erie; "Completed Calls vs. Cancellations," by Miss Frances Weaver, chief operator, Meadville; "Building, Clearing and Supervision of Toll Circuits," by Mrs. Lois Kohler, of Cambridge Springs, and "Timing and Report Charges," by Miss Myrtle Anderson, chief operator, Oil City.

Friday evening the officers, managers and operators enjoyed a banquet at the Hotel Conneaut, and a lively entertainment.

The concluding session was devoted to addresses by John H. Wright, general manager Jamestown Telephone Co., on "Public Relations," and "Standardizing Telephone Directories," by Perry Ballou, of R. R. Donnelly & Sons Co., of Chicago. "Precedence of Calls," by Miss Matilda Libel, of Butler; "The Necessity of Ticket Detail," by Miss Anna Mazzeo, of Erie, and "When a Call Is Considered Covered," by Mrs. Addie A. Dean, of Edinboro.

TEXAS' DISTRICT AFFAIR

First Sectional Meet of Year Is Held at Houston July 19th.

Houston, Tex.—More than half a hundred telephone men in territory convenient to Houston met in the first district session of the year, at the Bender hotel. President R. B. Still presided over the sessions. Opening the meeting was the address of Anson Miller, President of the Chambers County Telephone Co., Anahuac, on the benefits derived from association membership. George E. Rex, Vice-President of the National Lumber and Creosoting Co., spoke on creosoted pine poles, telling the service that could be expected from the southern product properly treated.

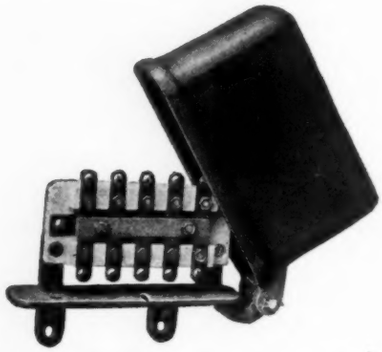
R. W. Garner, Plant Superintendent of the Texas Telephone Co., Waco, presented an interesting and practical address on underground construction for small exchanges. Mr. Garner's paper appears in full in this issue of TELEPHONE ENGINEER. Tribute was paid the small exchange operator by E. R. Evans, Traffic Supt. of the Texas Telephone Co., in his paper, "Selecting Operators for Small Exchanges." Due to the variety of situations confronting her, the small town operator must be above the average satisfactory for the larger exchanges, according to Mr. Evans.

"Ups and Downs of the Telephone Business," a talk wherein C. A. Shock, of Grayson, related experiences that chasten and elate the souls of telephone men, "Our Relations with the Public," by J. B. Earle, President of the Texas Long Distance Telephone

Uninterrupted Use of Telephone Wires

Drains Wires of Lightning Without Attention

OPEN WIRE LEADS



CAST IRON CASE

No. 202 SELF CLEANING Sawtooth Lightning Arrester for draining two to ten wires at the crossarm

Reliable Electric Company

3145 Carroll Ave., CHICAGO, U. S. A.

Co., and "What the Coming Legislature May Bring," by President Still, were other valuable addresses presented at the district gathering.

"Farmers and Telephones," a talk by M. H. Gossett, President of the Federal Land Bank, was a vivid presentation of the improvement of rural conditions effected by the telephone. The question box, in charge of John Stratton and C. D. Kinne, also was a feature of the affair.

Other district meetings are scheduled for Austin, August 17th, Brownwood, September 14th, Fort Worth, October 18th, and Tyler, November 16th.

Oklahoma's Fourth District Phone Folks Meet

Oklahoma City, Okla.—A two-day district session conducted by the telephone division of the Oklahoma Utilities Assn., proved profitable to the representative attendance of executives and operators. Features of the meeting were the address of O. D. Hall, Secretary of the organization, on its history, the paper of R. J. Benson, of the Southwestern Bell on "Accounting Methods," and of Campbell Russell, Chairman of the Oklahoma Corporation Commission. J. W. Walton, of the Broken Arrow Telephone Co., is Chairman, and L. W. Scherer, of the Yale Telephone Co., is Secretary of the group that successfully conducted this meeting.

Up-State New York District to Meet at Alexandria Bay

Albany, N. Y.—J. G. Ihmsen, General Manager of the Up-State Telephone Assn. of New York, has announced a district meeting for August 16th, at Alexandria Bay. F. S. Rodenhurst, President and General Manager of the Thousand Islands Telephone Co., will be host and will preside at the sessions.

Southern District Organizes in Illinois

Eldorado, Ill.—Representatives of 18 telephone companies in southern Illinois have formed the Southern Illinois Telephone Assn. D. B. Gates, president of the Harrisburg Independent Telephone Co., heads the new association. Its secretary is W. L. Ford, president of the Eldorado Telephone Co.

Clifford Arrick, Formerly Bell Publicity Man, Dead

Clifford Arrick, at one time publicity manager for the old Central Union Co. at Indianapolis, and for 12 years in the same position with the Chicago Bell headquarters, recently died in Chicago. Following his service with the Bell he was a banker, and later a broker, in Chicago.

American Pole Protective Co. Reorganized. Now "Appco"

Freeport, Ill.—The American Pole Protective Co., makers of an Armco iron pole protector and renewer, has been reorganized as The Appco Trust, Ltd. Necessity for financing the rapidly growing business, domestic and foreign, is given as the reason for the change.

South American Phone Statistics Issued by A. T. & T.

New York City.—Victor M. Berthold, statistician for the Bell, has compiled the telephone and telegraph statistics of American Republics, including the Guianas and British Honduras. For the most part, the statistics are compiled from government and private company figures.

Newark, O., Civic Bodies Urge Phone Rate Increase

Newark, O.—Nine of this city's civic organizations have recommended to the city council that a rate increase be granted the Newark Telephone Co.

Practical Plant Problems

Chapter V—The Development Study—Continued

By Charles W. McKay, Associate Editor

In the July installment, the general methods employed in the transcription of the house-count data; the evolution of the development study, proper, and the location of the central office, were discussed in a general manner. In the present installment, we will consider specific illustrations.

It will be remembered that, in connection with Figure 3 as presented in the June installment, a recapitulation of the house-count data was given in connection with the block under analysis. Also, in the June installment, ratios of party line stations to lines were cited. It was stated that a fair average ratio of two-party stations to lines, is 1.5 for the five-year period and 1.6 for the twenty-year period. On the basis of the same hypothesis, a ratio of 2.5 stations to lines for four-party service was given for the five-year period, and 2.7 stations to lines for the twenty-year period.

In order that the reader may understand, clearly, how these ratios are applied, in actual practice, to the data resultant from the house-count study —the statistics given in Figure 3 are reproduced in Figure 4, in this installment. Figure 4 also shows the results obtained by applying the various ratios to the station data. It will be noted that the classification of service is specified in the first column of Figure 4; the present numbers of stations and the number of lines required to serve these stations (as determined by the application of the ratios) are given in the second and third columns respectively; the numbers of stations and the number of lines required for the five-year period are given in the fourth and fifth columns and the numbers of stations and lines required for the twenty-year period are presented in the sixth and seventh columns. It has further been assumed that the respective ratios of two and four-party subscribers stations to lines, at the time of the investigation, are the same as the ratios used in connection with the five-year period. In other words, the ratio of two-party stations to lines is 1.5 for the present period, and the ratio of four-party stations to lines is 2.5. It should also be remembered that individual party service always requires a "line per station"—in other words, the number of lines, in each case, for single party service, will be the same as the number of stations.

Referring to Figure 4—after applying the ratios, we find that, considering the present period (the period at the time of survey), 16 lines are required for single-party business service, 5.33 lines for two-party business service, 5 lines for single-party residence service, 6 lines for two-party residence service, and 1 line for four-party residence service. This makes a total of approximately 33 lines, required to furnish service (for the block illustrated in Figure 3 of the June issue) at the time of the survey. At the end of the five-year period, 29 lines are required for single-party business service, 14 lines for single-party residence service, 8.66 lines for two-party residence service and 1.6 lines for four-party residence service. This gives a total of approximately 53 lines, or circuits, which will be required to supply the block with telephone service at the end of the five-year period. In the case of the twenty-year period—44 lines are required for single-party business service, 14 lines for single-party residence service, 8.66 lines for two-party residence service and 1 line for four-party residence service—making a total of approximately 68 lines required to meet the expected service requirements at the end of the twenty-year period.

Classification of Service	Present Stations	Present Lines Requires	5-Year Period Stations	5-Year Period Lines Required	20-Year Period Stations	20-Year Period Lines Required
A—Single Party Business.....	16	16.00	29	29.00	44	44.00
B—Two-Party Business.....	8	5.33	..	.....	..	.....
a—Single Party Residence.....	5	5.00	14	14.00	14	14.00
b—Two-Party Residence.....	9	6.00	13	8.66	13	8.66
c—Four-Party Residence.....	2	1.00	4	1.60	2	1.00
Totals	40	33.33 33.	60	53.26 53.	73	67.66 68.

FIGURE 4

In connection with the foregoing, it is hardly necessary to say that the line data is obtained by dividing the station data by the corresponding ratios. To illustrate, if we divide the 8 present two-party business stations by 1.5, we obtain the figure 5.33, which represents the number of lines required to serve the 8 two-party business subscribers, on the basis of the average ratios used. The method suggested in the foregoing paragraph —and illustrated in detail in Figure 4—should be used in connection with each of the city blocks, in determining the line requirements.

As suggested in the July issue, the next step in the development study involves the transcription of the line data—for both the five and twenty-year periods — from the individual block maps, to a suitably scaled city map. A map of 400 or 600 feet to the inch is preferable. Such a map is illustrated in Figure 5. With the thought that this whole problem of development studies, and the location of central offices, may be clarified by a specific illustration—Figure 5 is so designed as to represent an actual problem. It is assumed that a small section of a city or town is under consideration—and that the existing plant and subscriber development is negligible. This latter assumption is made to simplify the problem. A case of this kind might be found in the outlying section of a rapidly developing town or city—a section where a real estate "boom" warrants the assumption that there will be a rapid growth in the five-year period, and quite a large growth before the end of the twenty-year period.

In the figure, it will be noted that numerals in the form of "fractions," are included within the boundaries of each city block. The numerator of

each of these figures represents the number of lines expected within the five-year period, and the denominator, the number of lines expected before the end of the twenty-year period. It will be noted that the telephone "saturation" is most dense in the central portion of the map—this on the [illegible] The grand total of these numerators is 1,706 lines—as indicated at the lower right hand corner of the figure. One-half of 1,706 lines would be 853 lines. If we include all of the blocks from Aves. H to D inclusive, we will have a total of 1,051 lines. The horizontal center of density,

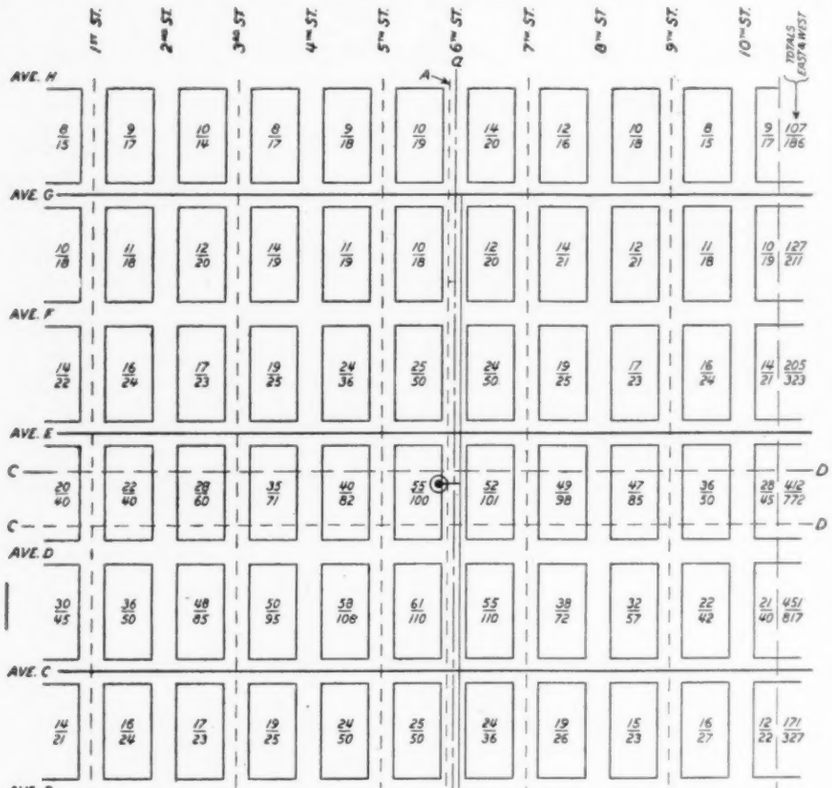


Fig. 5
ILLUSTRATING DEVELOPMENT STUDY.

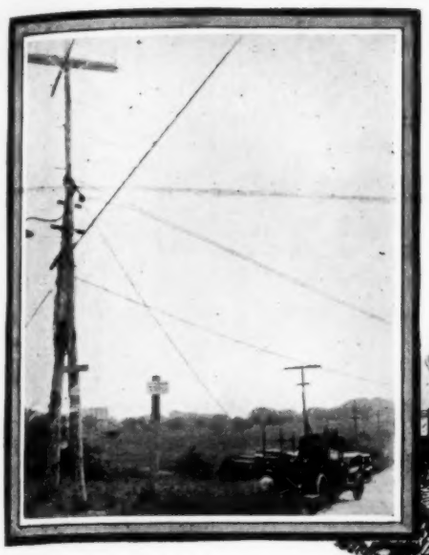
hypothesis that a prosperous business community will be required, at this location, to serve the commercial interests of the community in question.

It is obviously necessary to obtain the center of telephone density for both the five and twenty-year periods. For the five-year period, this is accomplished by totaling the numerators, in each city block, first in a horizontal direction, and then in a vertical direction. The results obtained by making these additions are indicated by the numerators of the fractions at the extreme right hand border of the figure. To illustrate, the total lines, for the five-year period, for the northerly row of blocks, is 107, the total for the row of blocks lying immediately to the south, 127, would, therefore, fall about the middle of the tier of blocks bounded by Ave. E on the north and Ave. D on the south. The center of density is indicated by the dotted and dashed line "c-d".

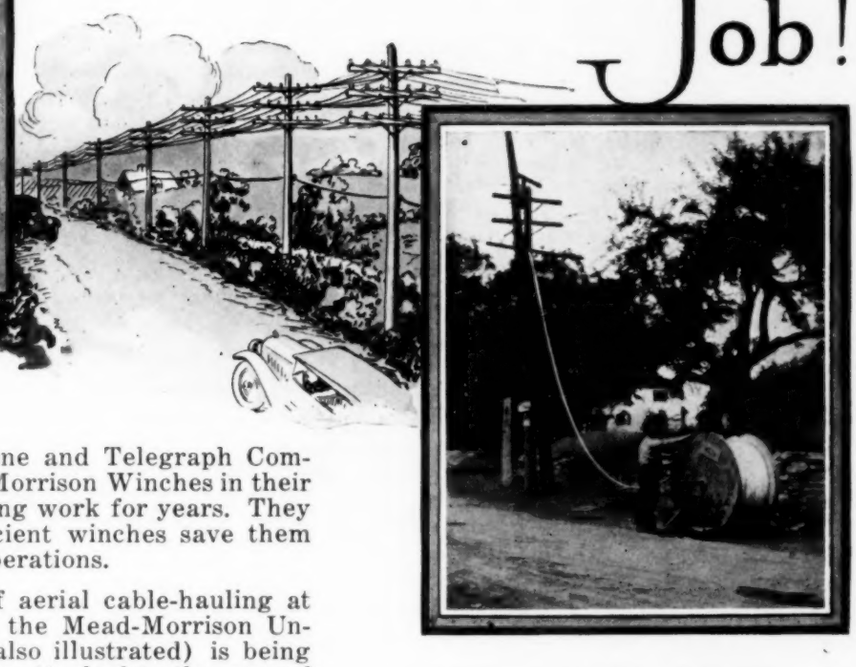
In a similar manner, we find that the center of density, (still referring to the five-year period) in a vertical direction would fall between 5th St. and 6th St. Starting at the left hand side of the map, there are 721 lines up to 5th St. and 927 up to 6th St. We have arbitrarily chosen 6th St. as being the probable location of the central office. The center of density, in a vertical direction, is indicated by the dotted and dashed line "a-b". The intersection of these lines indicates that the central office should, from a theoretical standpoint, be located on 6th St., about midway between Ave. E and Ave. D—at the intersection of the dotted and dashed lines.

An exactly similar method of procedure should be followed with respect to the twenty-year period. Referring to Figure 5, the vertical and horizontal density lines are indicated by the dotted lines "A-B" and "C-D", respectively. It so happens that the intersection of these lines — which shows the theoretical center of the telephone density at the end of the twenty-year period—lies near the southerly extremity of the block facing 6th St., on the west, between Ave. E and Ave. D. In this connection, it may be said that it is only on rare occasions that density centers — for the five and twenty-year periods—so nearly coincide. In view of the proximity of the two density centers, facts, we will tentatively locate the theoretical central office on 6th St.—about midway between Ave. E and Ave. D—as shown by the dot surrounded by a circle.

The determination of the theoretical location of the central office by no means completes the plant engineer's task. There are many other factors to be considered. In our present illustration, we have assumed that the existing telephone plant is negligible. However, if existing plant is present, the central office location must be so planned as to make maximum use of existing facilities — and at the same time, not upset the ultimate development scheme. Another factor to be taken into consideration is whether or not desirable property is available at, or in the immediate vicinity of, the theoretical central office location. It may be that—referring to our present illustration—6th St. between Aves. E and D, is bordered by property of very high market value—property of so high a value as to make the cost of land for central office purposes prohibitive. However, it usually happens that a careful examination and survey of the community immediately adjoining the proposed central office location will reveal the fact that desirable property is available within a relatively short distance of the theoretical office location. All of these factors must be given most careful consideration before definite action is taken. The plant engineer will undoubtedly have to adopt the "cut and try" method—in other words, he will have to make numerous plans and compare their relative merits. Among other things, such a comparison necessitates the determination of first costs and annual charges—as represented by the various schemes advo-



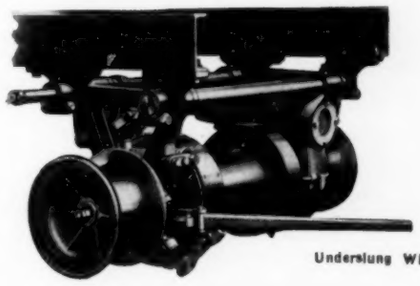
Making Aerial Cable-Hauling an Easier Job!



The New England Telephone and Telegraph Company has been using Mead-Morrison Winches in their pole-setting and cable-hauling work for years. They have found that these efficient winches save them time and money on many operations.

We illustrate here a job of aerial cable-hauling at Lawrence, Mass., on which the Mead-Morrison Underslung Winch No. 913 (also illustrated) is being used. This unusual winch is attached to the rear of the company's truck, making it more accessible for all types of work, and incidentally saving space on the truck floor.

The use of the Underslung Winch in aerial cable-hauling makes a continuous rate of speed possible, and permits of the use of a manila rope with its obvious advantages. The manila rope does away with the danger of short circuit, due to crossing with power lines, and is more easily coiled and handled. The Underslung Winch is adaptable for either underground or aerial cable-hauling, or for pole-setting. It also saves time in the handling of cable reels. The winch mechanism, being entirely enclosed, is weather and road proof and may be depended upon for reliable every-day performance.



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cated. In considering such first costs and annual charges, the engineer must not only consider the central office building and the land upon which the building is to be located, but he must also consider the first cost and annual charges of the feeder system adjacent to the office.

Having determined a central office site, desirable from all standpoints, the next task confronting the plant engineer is the preparation of a tentative "skeleton" layout of both feeder and distribution systems. Again referring to Figure 5—it will be noted that such a skeleton layout has been incorporated in the illustration. The heavy, full lines represent the feeder system, and the dotted lines represent the distribution system.

The main feeder artery will be located on 6th St.—probably extending north to Ave. G and south to Ave. A. This feeder artery will probably consist of underground conduit construction. The branch feeders—located on Aves. A, C, E and G respectively—will probably consist of aerial cables at least for some years to come. Ultimately, as the section represented in Fig. 5 expands (beyond the limit of our present illustration) the aerial feeders on Aves. A, C, E and G may have to be replaced by underground conduit construction.

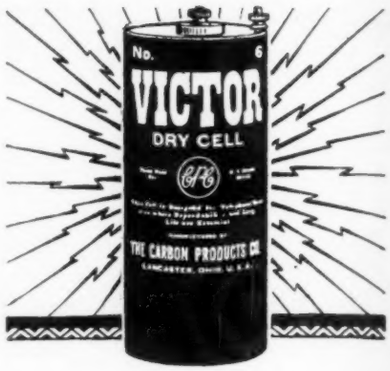
It has been assumed that—in the case under consideration—there are no alley-ways within the city blocks, and, therefore, that the feeder plant has to be located upon the highways. It has been further assumed that the blocks are of standard type—not over 200 or 250 feet in width—and that pole lines on alternate north and south streets will provide adequate distribution service. It may be well to pause for a moment and consider why the distribution pole lines are located upon the north and south streets—parallel to the longer dimensions of the blocks. If the distribution pole lines were placed upon the east and west streets—parallel to the shorter dimensions of the blocks—obviously, very long spans of drop wire would be required to reach the subscribers located near the middle of the blocks. By placing the distribution pole lines and cable and wire facilities parallel to the longer dimensions of the blocks the length of individual drop wire spans may be reduced to a minimum—for obvious reasons.

It is probable that during the initial portion of the five year period, it would not be necessary to install feeder facilities throughout the entire lengths of Aves. A, C, E and G. A feeder cable of sufficient size could be installed upon Ave. E—this cable serving aerial distribution cables on some of the northerly and southerly streets, and open wire facilities installed on the other distribution streets—where the immediate telephone requirements are not heavy enough to warrant the installation of aerial cable facilities. Such cables as are installed—at the time of initial installation—will be so spliced that they can be readily replaced at a future date, from additional feeder facilities on Aves. A, C and G respectively. This whole question of the splicing—and termination—of distribution cable facilities is a most important one, and will be dealt with in some detail in the September installment of this series. For the present, suffice it to say, that telephone plant engineering has been reduced to so exact a science that it is possible to place and splice long distribution feeder cables and to subsequently relieve them at a very small cost.

We have now reached the last stage of the development study proper—and this stage is really the initial step in the work involved in preparing the fundamental plan. Needless to say in planning both feeder and distribution facilities, in connection with the development study and fundamental plan, the plant engineer must bear in mind, not only the five year period, but also the twenty year period. He must so plan every unit of plant that it will fit in with the ultimate scheme—the word "ultimate" in this connection, refers directly to the end of the twenty year period.

Before leaving the subject of the development studies, it may be said that our illustration—as represented in Figure 5—presents about as many difficulties as are usually encountered in the layout of the small telephone plant. This for the reason that the city blocks are not bisected (parallel to their longer dimensions) by alleyways. Where there are alleys, distribution may be effected by much shorter dropwire spans.

In the September installment, the relation between the development study and the fundamental plan will be discussed—in connection with the evolution of the fundamental plan itself.



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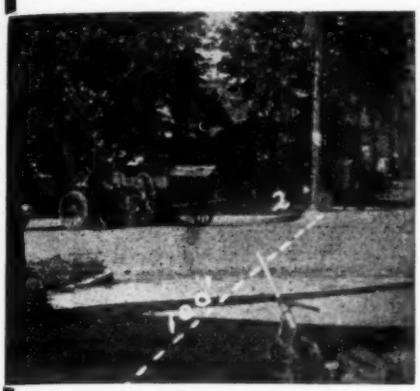

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ALTERNATING CURRENTS (EE-12-1)
HIGH FREQUENCY CURRENTS

NATURE OF HIGH FREQUENCY CURRENTS. By a high frequency current is meant an alternating current which has a frequency well above the ordinary "audio" or sound frequency, and therefore well above 15,000 cycles per second. In ordinary work where high frequency currents are employed, the frequency will average from 500,000 to 1,000,000 cycles per second. Such enormously high vibrations are directly or indirectly the result of a condenser discharge, and such discharges also set up etheric waves called "Hertzian" waves which have electrostatic and electromagnetic components.

Such currents have noticeably different characteristics than the low frequency currents used in lighting and power circuits, or rather certain characteristics of the low frequency currents are more pronounced when we get much above 1,000 cycles per second. The reactive effects of inductance rapidly increase with the frequency, hysteresis effects are more pronounced, and the current is no longer uniformly distributed over the cross-section of the conductor. The "skin effect" or the crowding of the current to the surface of the wire is much more noticeable at very high frequencies, hence under these conditions the resistance depends rather upon the surface area of the conductor than upon its cross-section or weight. Weight for weight a hollow tube has much better conductivity for high frequency current than a solid cylindrical section, and as a square section has greater superficial area than a round wire of equal area, the square is a more efficient conductor for H. F. than the ordinary circular section. This explains the use of square wires on certain high frequency apparatus. Stranded conductors are better than solid, especially stranded conductors with cotton centers. Thin flat tapes are also excellent H. F. conductors.

As an example of the skin effect, Thompson has shown that the current distribution at 25 cycles per second is practically uniform across the cross-section, at 100 cycles per second the current at a depth of 12 mm. is only about 1/7 its density at the surface. For the high frequency currents set up by the discharge of a leyden jar, which may reach several million cycles per second, the total depth of the current skin is less than 0.01 millimeter. Under such conditions, the increase in frequency leads to a great increase in the resistance of a given conductor and therefore corresponding increases the heating effect. The heating effect is at a minimum when the current distribution is uniform over the cross-section. All this is of importance in the consideration of lightning arresters and their connections, radio currents, condenser connections, and even in the transmission of the relatively low frequency telephone current. It probably is one explanation of why a lightning arrester may refuse to function, though the gauge of the ground wire may be such as to safely convey several hundred amperes.

The effect of high frequencies on inductance is very marked. Inductances which have no appreciable effect on alternating power circuits may become prohibitive to the passage of currents having a frequency of 1,000 cycles per second and over. A discharge from a leyden jar will often jump several inches in air in preference to flowing through a few turns of heavy wire wound into an inductance. By the use of suitable inductances, high frequency currents may be "filtered out" from low frequency currents or eliminated by inductively tuning them out as in radio. The low frequency current will pass through the inductance coil with little opposition, while the H. F. current is choked back. The frequency effect upon capacitance is just as noticeable, and is undoubtedly increased by the surface current density due to the skin effect. So great is the capacity effect that the inductive effect of inductance coils is seriously reduced because of the condenser action between adjacent turns or layers in the coil, and when more than one layer of winding is used the capacitance is increased to such an extent that the coil becomes very inefficient.

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PROTECTIVE DEVICES (Q-2-1)
LIGHTNING ARRESTERS

NATURE OF LIGHTNING. Despite the fact that lightning is commonly accepted as an electric discharge, such cannot be absolutely proved, and the fact that ordinary lightning arresters and protectors based upon this theory are not always effective rather backs up the idea that lightning differs from electricity in many particulars. According to several modern investigators, lightning is accompanied by static electricity rather than being pure static in its entirety. The observed differences between electricity and lightning may be summarized as follows:

1. If a lightning flash were purely electrical, then each flash would be accompanied by a deluge of nitric acid. This we know is not the case.

2. That certain metals which prove the best conductors for electricity are far from being the most perfect lightning conductors.

3. That the energy of a flash of pure static would contain many times the disruptive energy apparently contained by a lightning flash.

4. That corona streamers are entirely lacking in the vicinity of highly charged clouds where they most certainly would be in evidence with a pure static charge.

5. That the waves of electro-static and electromagnetic energy given off by a lightning discharge are not comparable with the energy given off by an equivalent electrical discharge. If this were the case, then radio transmission would be an impossibility.

Lightning, however, does produce many of the effects of electricity, hence the modern theory that such discharges are built up of two components, one electrical and one consisting of a yet unidentified form of energy, possibly similar to the violet ray or some similar display. Among the purely electrical characteristics may be mentioned the properties of condensence and inductance, the ability to induce electrical currents in adjacent conductors, and the tendency toward discharging to ground. The whole problem is still in question owing to the difficulty of making experimental investigations, but it is certain that lightning protective devices will never be absolutely effective until the whole story is known. At present, we are equipped only to handle the static component.

ATMOSPHERIC ELECTRICITY. The fact that the atmosphere is usually in an electrified condition has naturally led to the idea that lightning is purely electrical. It has been determined that during fine weather the air above the surface of the earth is positively charged in regard to the earth's surface. This is really simply a relative polarity since the charges of the air and earth are only differences of potential. This relative positive charge increases as we increase our altitude, the rate as determined by Kelvin increasing by 40 volts per foot of height in clear weather. In broken weather or during rain, the charge is more often negative than positive, but in cases where isolated masses of clouds are being blown across the sky, the polarity will fluctuate very rapidly, often changing from positive to negative, and from negative back to positive several times during an hour. On the passage of a positively charged cloud, Kelvin found that the increase of charge per foot of elevation was increased from five to ten times that observed in cloudless weather.

It is well known that atmospheric static reaches a higher intensity in summer than in winter, and that the charge is greater during the sunlight hours than at night. Hot dry winds tremendously increase the charge, often making it impossible to dispose of all of the charge by ordinary grounding methods that are perfectly effective in cool still weather. The receiving radius of radio stations is very much reduced under such conditions, it being possible to receive from broadcast stations in cool still weather that are never heard during the summer months or when a high wind is blowing.

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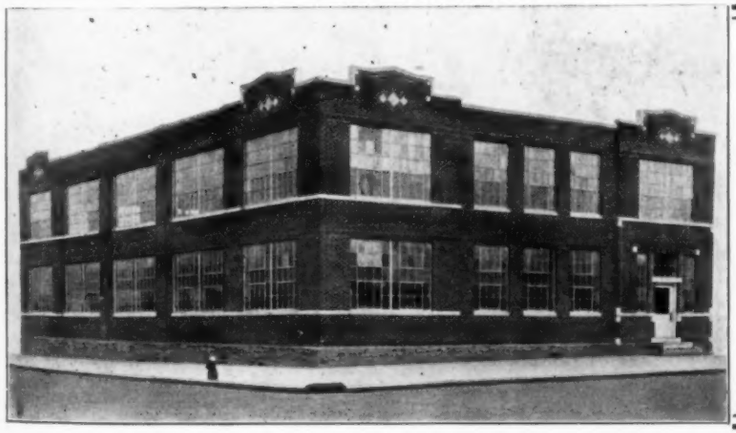

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MATHEMATICAL TABLES (BB-1-1)

LINEAR UNITS OF MEASURE

DECIMAL EQUIVALENTS OF FRACTIONS. The following table will be of use in converting fractions of an inch into decimals or vice versa. A parallel table of millimeters is also given so that the metric equivalent of a given fraction of an inch can be easily found.

Fractions Inch	Decimals Inch	Equivalent Millimeters	Fractions Inch	Decimals Inch	Equivalent Millimeters
1/64	0.015 625	0.397	1/2	0.500	12.700
1/32	0.031 25	0.794	33/64	0.515 625	13.097
3/64	0.046 875	1.191	17/32	0.531 25	13.494
1/16	0.062 5	1.588	35/64	0.546 875	13.891
5/64	0.078 125	1.984	9/16	0.562 5	14.288
3/32	0.093 75	2.381	37/64	0.578 125	14.684
7/64	0.109 375	2.778	19/32	0.593 75	15.081
1/8	0.125	3.175	39/64	0.609 375	15.478
9/64	0.140 625	3.572	5/8	0.625	15.875
5/32	0.156 25	3.969	41/64	0.640 625	16.272
11/64	0.171 875	4.366	21/32	0.656 25	16.669
3/16	0.187 5	4.763	43/64	0.671 875	17.066
13/64	0.203 125	5.159	11/16	0.687 5	17.463
7/32	0.218 75	5.556	45/64	0.703 125	17.859
15/64	0.234 375	5.953	23/32	0.718 75	18.256
1/4	0.250	6.350	47/64	0.734 375	18.653
17/64	0.265 625	6.747	3/4	0.750	19.050
9/32	0.281 25	7.144	49/64	0.765 625	19.447
19/64	0.296 875	7.541	25/32	0.781 25	19.844
5/16	0.312 5	7.938	51/64	0.796 875	20.241
21/64	0.328 125	8.344	13/16	0.812 5	20.638
11/32	0.343 75	8.731	53/64	0.828 125	21.034
23/64	0.359 375	9.128	27/32	0.843 75	21.431
3/8	0.375	9.525	55/64	0.859 375	21.828
25/64	0.390 625	9.922	7/8	0.875	22.225
13/32	0.406 25	10.319	57/64	0.890 625	22.622
27/64	0.421 875	10.716	29/32	0.906 25	23.019
7/16	0.437 5	11.113	59/64	0.921 875	23.416
29/64	0.453 125	11.509	15/16	0.937 5	23.813
15/32	0.468 75	11.906	61/64	0.953 125	24.209
31/64	0.484 375	12.303	31/32	0.968 75	24.606
			63/64	0.984 375	25.003
			1	1.000 000	25.400

The above table is based on the equivalent of 1 inch = 25.4 millimeters, which is close enough for all practical work.

In practically all shop measurements, the fractional divisions of the mechanic's scale are given in terms of 1/4 and even multiples thereof, the common fractions being 1/2 inch, 1/4 inch, 1/8 inch, 1/16 inch, 1/32 inch and 1/64 inch. In late years, the fractional inch system of measurement has been rapidly giving away to the more flexible and easily handled decimal system, and this is particularly true in the classes of work where the micrometer is used. When used decimally, the English inch has practically all of the advantages claimed for the metric system, and this method presents the advantages of not causing the confusion and changes in standards that would be attended by the adoption of the metric system.

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MATHEMATICAL TABLES (BB-1-2)

LINEAR UNITS OF MEASURE

ODD DECIMAL EQUIVALENTS. While the divisions of the inch are generally in multiples of two in ordinary shop practice, yet it often becomes necessary to obtain the decimal equivalents of other systems of fractions, which may be called "odd" fractions. These cover such fractions as 1/6, 1/7, 1/12, 1/14, 1/24 and 1/28. These equivalents are given in the following tables:

DECIMAL EQUIVALENTS OF 6ths, 12ths and 24ths OF AN INCH

Fraction	Decimal	Fraction	Decimal
1/24	0.041 667	13/24	0.541 667
1/12	0.083 333	7/12	0.583 333
3/24	0.125	15/24	0.625
1/6	0.166 667	4/6	0.666 667
5/24	0.208 333	17/24	0.708 333
3/12	0.250	9/12	0.750
7/24	0.291 667	19/24	0.791 667
2/6	0.333 333	5/6	0.833 333
9/24	0.375	21/24	0.875
5/12	0.416 667	11/12	0.916 667
11/24	0.458 333	23/24	0.958 333
3/6	0.500		

DECIMAL EQUIVALENTS OF 7ths, 14ths and 28ths OF AN INCH

Fraction	Decimal	Fraction	Decimal
1/28	0.035 714	15/28	0.535 714
1/14	0.071 429	4/7	0.571 429
3/28	0.107 143	17/28	0.607 143
1/7	0.142 857	9/14	0.642 867
5/28	0.178 571	19/28	0.678 571
3/14	0.214 286	5/7	0.714 286
7/28	0.250	21/28	0.750
2/7	0.285 714	11/14	0.785 714
9/28	0.321 429	23/28	0.821 429
5/14	0.357 143	6/7	0.857 143
11/28	0.392 857	25/28	0.892 857
3/7	0.428 571	13/14	0.928 571
13/28	0.464 286	27/28	0.964 286
7/14	0.500	1	1.000 000

DECIMAL EQUIVALENTS OF 9ths, 18ths and 36ths OF AN INCH

Fraction	Decimal	Fraction	Decimal
1/36	0.027 778	19/36	0.527 778
1/18	0.055 556	5/9	0.555 556
3/36	0.083 332	21/36	0.583 333
1/9	0.111 109	11/18	0.611 111
5/36	0.138 886	23/36	0.638 888
3/18	0.166 663	6/9	0.666 666
7/36	0.194 439	25/36	0.694 444
2/9	0.222 222	13/18	0.722 222
9/36	0.249 999	27/36	0.750 000
5/18	0.277 778	7/9	0.777 778
11/36	0.305 555	29/36	0.805 555
3/9	0.333 333	15/18	0.833 333
13/36	0.361 111	31/36	0.861 111
7/18	0.388 886	8/9	0.888 889
15/36	0.416 666	33/36	0.916 667
4/9	0.444 444	17/18	0.944 444
17/36	0.471 111	35/36	0.972 222
9/18	0.500		

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